IN THIS ISSUE: AMERICA'S AERONAUTIC NEEDS AND POSSIBILITIES

AVIATION
AND
AERONAUTICAL ENGINEERING

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St. Peter's Church at Rome, Seen from an Airplane

APRIL 1st 1917

PRICE Ten Cents

SPECIAL FEATURES

THE SAFE AND USEFUL AIRPLANE

SOME PSYCHOLOGICAL ASPECTS OF AERONAUTICS

COURSE IN AERODYNAMICS AND AIRPLANE DESIGN

THE STANDARD AERO CORPORATION MODEL J TRAINING TRACTOR

THE GRAPHICAL DETERMINATION OF A STRUT HAVING UNIFORM STRENGTH

PUBLISHED SEMI-MONTHLY
BY
THE GARDNER, MOFFAT CO., Inc.
120 W. 32nd ST. NEW YORK

HALL-SCOTT

These general views of the Hall-Scott machine shop show various types of modern high speed machinery, all equipped with individual motor drive. Special jigs, templates and tools are provided for the different machines hy the tool room department, a part of the Hall-Scott scheme of completeness in modern shop practice.

HALL-SCOTT

The Smaller, Gas heated, Annealing and Hardening Furnaces

The heat treatment of parts in Hall-Scott airplane engines plays a most important part in the proper halance of sturdy construction coupled with light weight. These furnaces, designed and constructed hy Hall-Scott engineers, are a part of the equipment necessary to the final perfection of the Hall-Scott product. Electric pyrometers give ahsolute check of correct temperatures necessary for heat treatments.

The Larger, Crude Oil Heated, Annealing and Hardening Furnaces.

HALL-SCOTT

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HALL-SCOTT

Hall-Scott Airplane Engine Open Air Test Stands

The Hall-Scott Company has always considered proper running tests upon airplane engines of vital importance to the success of the equipment under actual service conditions.

Hall-Scott facilities for proper testing out of their engines, with directly connected propeller and under running conditions closely approximating those met with in actual flying service, are undoubtedly the most comprehensive and elaborate ever devised or installed at any factory in this country.

After Hall-Scott engines are assembled and turned over to the test department, they are run in with belt drive from electric motor. They are then placed on outside test stand and run under their own power for the period of time that may be required. (Present Government requirements provide for from three to six hours continuous full power runs, disassembly and inspection, reassembly and final one hour continuous full power run.)

They are then disassembled, all parts carefully inspected, reassembled and given one hour continuous full power run.

Hall-Scott Motor Car Co., Inc.
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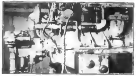
THE PERFECT STARTER

Model C Starter Mounted on a 6 Cylinder Hall-Scott Engine



Model D Starter Mounted on a 6 Cylinder Hall-Scott Engine

It is an air motor for starting, and a compressor to store air for its own energy in starting.

It replenishes its energy for starting in less time than any other starting system in existence.

It is entirely self-contained.

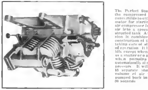
It couples direct to the end of crankshaft of motor.

It needs no alteration in motor or other gear reduction for attachment.

It has ample power and speed for magneto starting.

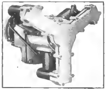
Model C—For starting engines up to 250 H.P. The device weighs 39 pounds, and complete with every fitting for single engine installation 70 pounds; for twin engines 110 pounds.

Model D—For starting engines up to 150 H.P. The device weighs 34 pounds, and complete with every fitting for single engine installation 58 pounds; for twin engines 96 pounds.



Model C

The Perfect Starter is of the compressed air type convertible to either an air motor for starting or an air compressor for storing air into a specially constructed tank. A transmission is combined in the construction of the device taking care of all changes of operation. It is entirely idle except when in action as a starter or a pump, and when pumping releases automatically at maximum pressure. It will average 15 separate starts on a volume of air which is pumped back in less than 30 seconds.

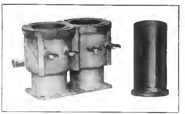


Model D

The Perfect Starter has been tested and approved by the United States, British, Dutch, Norwegian and Swedish Governments

THE MOTOR-COMPRESSOR COMPANY, Newark, N. J., U. S. A.

Used Extensively on Hall-Scott Engines



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Hyde Park, Boston, Massachusetts

APRIL 1, 1917

AVIATION
AND
AERONAUTICAL ENGINEERING

VOL. II. NO. 5

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Vol. II April 1, 1917 No 5

THE article on "America's Aeronautic Needs and Possibilities" by Dr Charles D Walcott which appears in this issue of AVIATION AND AERONAUTICAL ENGINEERING should go far to clear up the confusion which has existed in the industry as well as in lay minds regarding the problems which must be solved if the United States is to build up a real aerial arm

The article shows, first of all, the neglect from which the industry has suffered in the past The Army and Navy together ordered less than 100 machines in the eight years prior to 1916

At the outbreak of the European war the British air service was worse off than America is today The Royal Flying Corps had only eighty six serviceable machines, and of these sixty six were sent to France

Lessons of the European War

The air service on the continent proved itself the invaluable fifth arm without which the usefulness of the infantry and field artillery, at least was greatly restricted if not practically nullified So Great Britain set about to get airplanes

In its efforts to get airplanes Great Britain made almost every conceivable mistake Progress and improvement were discouraged by the Royal Aircraft Factory's activities The Royal Flying Corps and the Royal Naval Air Service did not cooperate and in fact competed with one another in a manner which made prices soar but did not produce machines The inspection departments of the two services failed to cooperate and as a result all sorts of different standards and tests were laid down There was much useless duplication of effort and waste of time These mistakes are appreciated in Washington today Great Britain's errors are serving to point out the straight road to the United States

Great Britain has solved her biggest problem Today airplanes are being delivered in large quantities to the R F C, and the R N A S This result is largely due to the fact that with practically every order for planes engines or parts a deposit of twenty-five per cent in cash was made by the government with the manufacturer

This practice is specifically forbidden by law at the present time in this country A part of Section 3648 of the Revised Statutes, United States, reads

"No advance of public money shall be made in any case whatever And in all cases of contracts for the performance of any service or the delivery of articles of any description for the use of the United States, payment shall not exceed the value of the service rendered, or of the articles delivered previous to such payment

However, there is no question that Congress by special legislation can authorize advances of money This policy has been tried by Great Britain and it has proved successful It is a policy which would help to solve the greatest problem now confronting the United States Army and Navy air services, which is the problem of how to get more machines, especially machines of military types

The Pressing Personnel Problem

The personnel question, the problem of getting enough fliers, depends first of all on the solution of the problem of how to get machines Secondly comes the question of getting flying instructors, which presents innumerable difficulties The art of teaching others to fly is a different art from the mere flying of a machine Thirdly, the question of getting airplane mechanics arises Good airplane mechanics are rare in America and it is a mistaken notion that a knowledge of an automobile engine fits a man to care for and repair airplane engines The latter are far more delicate and they require quite different handling An airplane mechanic, too, should have a thorough knowledge of how to set up and align an airplane He should understand the installation and care of all bracing drift and control wires

Lastly, comes the question of getting trained military pilots. According to Dr Walcott's article the training of a pilot takes about nine months, involves the wearing out of an airplane and takes one fifth of the time of a flying instructor. After 1919 Dr. Walcott's program contemplates the instruction of 2,000 aviators yearly. To accept Dr Walcott's figures of wastage means that 2,000 airplanes will have to be built yearly for training purposes as well as fighting machines of every type by an industry whose total production for 1917 is liberally estimated to be 700 machines for the American Army and Navy Such figures give a bare indication of the future in store for the industry in the military field alone

To sum up the situation briefly today the greatest need of the United States is for more facilities to produce airplanes Until a sufficient number of airplanes can be purchased the patriotic offers of the thousands of young men who wish to learn to fly can not be accepted Only a limited number can be trained because there are in this country today only a few fliers competent to give instruction, because this country has only a comparatively small number of trained airplane mechanics and because the output of airplanes is limited by the inadequate manufacturing facilities

The Graphical Determination of a Strut Having Uniform Strength*

Abstract by E. L. Gavhart, U. S. N.

It is the custom for manufacturers to taper their struts, but this is ordinarily done by eye, and the tapered struts in use to-day are unlikely to be very efficient except where their defects have been accentuated by unfortunate failures. The following method proposes to determine by a graphical process the correct taper for a strut such that, when loaded as a column, it shall have uniform strength throughout its length.

The graphical process by which the proper sections are determined for a strut of uniform strength is carried out by means of the integraph, and is based on the two following formulæ:

$$-EI\frac{d^2y}{dx^2} = Wy \qquad (1)$$

$$f = -bE\frac{d^2y}{dx^2} \qquad (2)$$

Fig. 1

where

E = modulus of elasticity of the material

I = the (least) moment of inertia at any section distant x from the origin

W = the critical load for the strut

y = deflection at any section for a strut loaded as in the diagram, (Fig. 1) and

f = the maximum stress at any section

b = the distance from neutral axis to most strained fiber

end $\frac{d^2y}{dx^2}$ = the second derivative of the elastic curve of the strut.

Then with the strut of length $= 2L$ and symmetrical about the line $x = L$, the following conditions hold:

when $x = 0$, $\frac{d^2y}{dx^2} = 0$

$\frac{dy}{dx}$ = some initial value $= h$

$y = 0$

and when $x = L$, $\frac{dy}{dx} = 0$

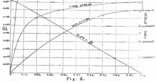


Fig. 2.

If we assume values of W and have a table or curve showing the values of I at the various sections, we may draw by a process of trial and error, curves that will fulfill the above conditions. The correct value of W or the crippling load for the strut will be that one which causes the $\frac{dy}{dx}$ curve to cross the axis at mid-length of the strut. But we are desirous of designing a strut for a given load rather than of finding the crippling load for a given strut, and accordingly proceed by the reverse of the method just suggested, starting with a curve of $\frac{d^2y}{dx^2}$ assumed practically uniform as a first trial since the fiber stress varies with $\frac{d^2y}{dx^2}$ and we wish to obtain uniform fiber stress. This assumed curve is shown in Fig. 2. When this curve is integrated with the integraph, there results a curve of $\frac{dy}{dx}$ and the integral of this second curve is a curve of deflections, i.e., the elastic curve of the strut for a given load, and with the assumed $\frac{d^2y}{dx^2}$ curve.

Equation (1) may be transformed to the following

$$I = \frac{Wy}{E\frac{d^2y}{dx^2}} \text{ or } I = \frac{Ky}{\frac{d^2y}{dx^2}} \text{ where } K = \frac{W}{E}$$

In the preceding paragraph, K is assumed as 1 and the equation becomes

$$I = \frac{y}{\frac{d^2y}{dx^2}}$$

and by means of this last equation, we obtain the moment of inertia of the several sections of the strut by dividing the ordinates of the deflection curve by those of the $\frac{d^2y}{dx^2}$ curve, with due regard for instrument constants and the scales of the graphs. Then from the moments of inertia, the diameters of the sections are obtained.

Lastly, from equation (2), it is seen that the fiber stress is proportional to the product of b and $\frac{d^2y}{dx^2}$. Therefore, if for each section we multiply the diameter and value of $\frac{d^2y}{dx^2}$ together, the product is proportional to the fiber stress at that section, and from the several products, a curve of relative fiber stress may be plotted.

When the above procedure was carried out for the curves of Fig. 2, the fiber stress curve showed far from uniform stress.

By successive trials, a curve of $\frac{d^2y}{dx^2}$ was found, yielding a stress curve as shown in Fig. 3. This curve was considered satisfactory as a basis for the dimensions of the test struts.

It should be noted that the foregoing is based on the assumption that $K = \frac{W}{E} = 1$. From equation (1), we may obtain

$$-\frac{d^2y}{dx^2} = \frac{Wy}{EI}$$

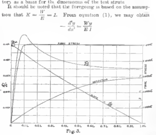


Fig. 3.

* Abstract of a Thesis by C. F. Lyons and E. P. Hanford at the Massachusetts Institute of Technology, 1916. Published by courtesy of Professor C. H. Peabody, Naval Architecture Department, Massachusetts Institute of Technology.

and from this it is evident that when the ratio of W/E is changed, I must be changed in the same ratio, if the relation of y to $\frac{d^2y}{dx^2}$ is not to be affected. Therefore, with a strut once determined for a given load, it is a simple matter to design one for any other load, since it is only necessary to change the I of all the sections accordingly, with corresponding change in diameter.

MAKING THE STRUTS

A length of 60 inches was decided on for the struts, as this was about the maximum that could be handled easily in a lathe. The material was well-seasoned, straight grained, western spruce. The struts were first planed octagonal, then turned down to within 0.01 inch of the correct dimension, using special cutting tools and steady rests designed for this purpose. The final hundredth of an inch was removed by sandpaper.

The dimensions to which the struts were made follow:

Section	Diameter in inches — Type A	B	C
0.0L	1.55	1.16	1.24
0.1L	1.72	1.33	1.40
0.2L	2.03	1.57	[illegible]
0.3L	2.34	1.73	[illegible]
0.4L	[illegible]	1.88	1.88
0.5L	2.63	1.97	1.97
0.6L	2.73	2.04	2.04
0.7L	2.79	2.09	2.09
0.8L	2.84	2.13	2.13
0.9L	2.86	2.14	2.14
1.0L	2.81	2.14	2.14

Six cylindrical struts were made, three with a diameter equal to the maximum diameter of type A, and three with a diameter equal to the maximum of type B. Three tapered struts were made of each of the types, A, B, and C.

Fittings were machined from cast iron for the ends of the struts. These are shown in Fig. 4, where there is also shown the socket made to receive the end-fitting in the base of the testing machine. After testing the large cylindrical struts, it was found that the knob of the fitting would act equally well if allowed to bear directly upon the base of the machine instead of resting in the socket. It was also found that the knobs became indented from the pressure and that they should have a radius of at least 7½ inch. Furthermore, by reference to A and B, Fig. 5 it will be seen that a fitting of this type gives the strut a bending moment at the end, after the strut is deflected.

Fig. 4

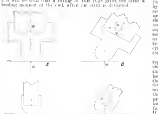


Fig. 5

This type of fitting was therefore discarded, and fittings of the type shown in Fig. 6 used thereafter. These fittings are so designed that the center of the spherical surface coincides with the center of the end of the strut, with the result that the line of action of the load W always passes through this point of the strut and any bending moment at the strut end is thus avoided. This feature of the second type of fitting is shown by C and D of Fig. 5. These improved fittings were used on the last six struts tested.

TESTING THE STRUTS

Both large and small cylindrical struts failed by crushing

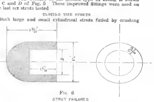


Fig. 6

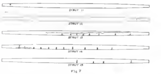


Fig. 7

at mid length. The large tapered struts of type A, as well as the small tapered struts of type B, failed by crushing near the ends, while the struts of type C failed by longitudinal shear and crushing at several points simultaneously. The failures of the struts of types B and C are shown in Fig. 7, while the loads and details of the tests are shown in the following table. The moments of inertia of the sections of type A are about three times as great as those of the same sections of type B, and it should be noted that the crippling loads of the former are about three times as great as those of the latter.

All the tapered struts except those of type C were proportioned from the curve shown in Fig. 3. In this figure it is seen that the fiber stress rises to a maximum between $0.1L$ and $0.2L$, which is where the struts broke. With this in mind, the last three struts (those of type C) were made slightly larger at the ends so that the stress dropped here, but remained practically constant throughout the remainder of the length. In these struts, failure occurred at several points at once. It is a significant fact that these failures always began along a sand-paper scratch.

CONCLUSIONS

A tapered strut cannot have the same crippling load as a straight strut of the same maximum diameter and at the same time have a uniform fiber stress throughout the length.

The tapered strut will stand only 80

per cent of the load the straight strut will stand, but the saving in weight of the tapered strut over the straight is 30 per cent.

The straight strut fails completely at maximum load, but the tapered strut bends under the load, returning to the original position without permanent set. In the photograph shown, the machine had gone far past crippling, but no signs of crushing were apparent. The strut bowed 2 inches more before failing.

Reference: *Critical Loads for Long Struts of Varying Section*. By L. Bairstow and E. W. Stedman. *Engineering* (London) October 2, 1914, page 403.

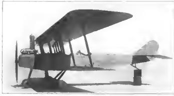
TABLE SHOWING DETAILS OF TESTS.

Type of strut	l/r	Largest diameter Inches	Crippling load Pounds	Weight of strut, Pounds	Ounces
Straight	83	2.87	12150	5	10
	83	2.87	13400	5	10
	83	2.87	10200	5	1
	113	2.14	7850	3	2
	113	2.14	4800	3	10
	113	2.14	5850	[illegible]	13
Tapered	83	2.87	9300	4	9
	83	2.87	9000	4	4
	83	2.87	5000	4	7
	113	2.14	2800		
	113	2.14	4200	2	10
	113	2.14	3550	2	5
	113	2.14	3900	2	11
	113	2.14	4000	2	6
	113	2.14	1400	2	3

The Standard Aero Corporation Model J Training Tractor

The Standard Aero Corporation of Plainfield, N. J., has announced its model J, 100 hp. two-place dual control training tractor, from designs of Charles H. Day.

Throughout the construction every effort has been made to turn out an ideal training type of airplane. The gross weight of the machine loaded is 1950 lb. and as the wing supporting surface measures about 430 sq. ft. the airplane has a low wing loading of only 4½ lb. per sq. ft., which permits, with the slow-speed, good climb R. A. F. No. 3 wing section, of a low landing speed of 37 m.p.h.



THE MODEL J ON THE SANDS AT DAYTONA BEACH, FLA.

A four-cylinder A-7 100 hp. Hall-Scott engine is used. With a gross weight for the entire airplane of 1950 lb., this gives a loading of 19.5 lb. per horsepower.

Special attention has been given to the construction of a sturdy landing chassis. The three-wheel construction is designed to prevent nosing over in bad landings.

The wings are swept back 5 degs. for stability's sake. The cooling radiator is mounted in accordance with German practice on top of the engine, and well in the rear of the propeller to insure adequate air circulation. The covering of the wings and all the linen work of the body shows many refinements and gives an indication of the careful manufacturing work which has characterized the machine. Wing fittings are of a complicated character employing brazing very similar to the familiar fittings used in the model H3, two place reconnaissance machine. The tail-skid is of conventional design. Ample control surfaces are employed and close attention has been paid to vertical fin area and area of of the fixed stabilizer in the design.

The wings are staggered and the top plane which alone has ailerons attached, overhangs the lower plane about 6 feet on each side. The specifications and performance guaranteed by the Standard Aero Coporation are as follows:

Dimensions, Specifications and Performance of the Model J

General Dimensions

Wing span: upper plane	43' 10 7/16"
Wing span: lower plane	32'
Depth of wing	6'
Gap between wings	5' 11 7/16"
Stagger	4'
Overall length of machine	26' 5"
Overall height of machine	10' 10 7/16"
Angle of incidence	2°
Dihedral angle	3°
Sweepback	5°
Wing curve	R. A. F. No. 3
Number of ailerons (on upper planes only)	2
Horizontal stabilizer—angle of incidence	0

Body

Length	22' 10½"
Width	30"
Depth	32"

Areas

Upper wing	264 sq. ft.
Lower wing	165
Total supporting surface (wings and ailerons)	429
Ailerons (each 21 sq. ft.)	42
Stabilizer—horizontal	23.7 sq. ft.
Stabilizer—vertical	3.7
Elevators (each 11 sq. ft.)	22 sq. ft.
Rudder	9
Maximum load per sq. ft. (supporting)	4.4 lbs.
Maximum load per H.P.	19.5 "

Weight

Net weight—Machine empty (including water and accessories)	1350 lbs.
Gross weight—Machine loaded	1950

Performance

Maximum speed—full load	68 M. P. H.
Minimum speed—full load	37
Climbing speed (in ten minutes)	2000'
Range of action (economical speed)	350 mi.
Gliding angle	1 to 8

Engine

Make	Hall-Scott
Type	A 7 90-100 H.P.
No. of cylinders (vertical)	4
Weight	410 lbs.
Fuel consumption per hour	11½ gal.
Fuel tank capacity	31
Oil capacity (in crank case)	3

Propeller

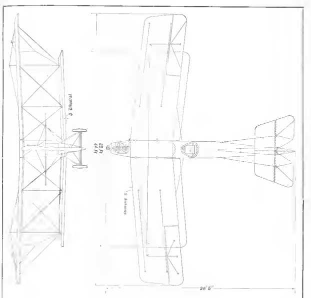
Make	"Standard"
Material	Black walnut
Pitch; Diameter	as required by performance
Direction of rotation (from pilot's seat)	Clockwise

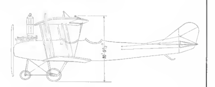
Landing Gear

No. of wheels	
Size of wheels	Two 26" x 4" and one 20" x 4"
Shock absorbing system	Pantograph rubber

Controls

Number	2
System	Dep. interchangeable with Curtiss





STANDARD AERO MODEL J TRAINING TRACTOR

Some Psychological Aspects of Aeronautics*

By Dr. Harold E. Burtt

The past few years have marked a rapid extension of theoretical psychology to the problems of practical life. Questions of vocational guidance and selection, industrial efficiency, mental diseases and their cure, legal organization, education, and even the appreciation of art, have recently been approached from a psychological standpoint. The contact between the theoretical and the practical realms is, in most cases, mutually beneficial. We can, for instance, do much practical work in the treatment of mental disease, while, on the other hand, the study of the abnormal throws much light on the functioning of the normal mind in which the theoretical psychologist is primarily interested. It was with this mingling of interests that the present problem was undertaken—interests in both the practical psychological aspects of aviation and the theoretical problems of the sense of equilibrium.

A complicated apparatus is employed to produce the desired changes in equilibrium. The subject on whom the experiments are performed sits on a chair upon a platform three feet square. This platform rocks on a rounded plate a foot below its centre, and is held in a horizontal position by heavy spiral springs attached from its four corners to the floor. Wire ropes from the corners pass through pulleys directly below and thence through other pulleys to a sprocket actuated by a crank and worm gear. By connecting the proper ropes and turning the crank, the subject can be tipped from a horizontal position in various directions and at various rates.

The method employed, for the most part, has been to turn the crank by hand, timing the speed by listening at a telephone receiver strapped to the ear, to the laboratory time-circuit, which makes an electrical contact every second. Connections were arranged so that a circuit was closed momentarily the instant the platform began to tip, and was closed a second time by the subject with a telegraph key the instant he was certain as to the direction in which he was being tilted. This circuit actuated a device which recorded time to fiftieths of a second. Thus by giving many trials and averaging reaction times, the delicacy of perception of changes of equilibrium in the different directions could be determined. The motion always started with the platform in a horizontal position. The trials were given in four directions—left, right, front and back—in irregular orders and at various rates of movement, with due regard to such factors as practice, fatigue, space and time errors, suggestion, and the like.

SENSE OF EQUILIBRIUM

This sense of equilibrium arises mainly from small organs in each inner ear. Adjoining the organ of hearing are three semi-circular canals filled with a watery fluid. These canals are arranged in three different planes, and as the fluid in one or more of them changes its position with the rotation of the head, it stimulates delicate nerve endings at certain points in the walls of the canals. Another somewhat similar apparatus (the vestibule) adjoining the canals gives sensations of movement in straight lines. As might be expected, the majority of the judgments given by those who took part in the experiments were based on apparent sensations in the head. Other factors, too, such as pressure from the chair or platform were found to be involved to a certain degree.

The main problem investigated up to the present has been the relative delicacy of perception of a tilting in the four directions—front, back, left and right. It would seem that if such differences were found to exist in general they would have a practical bearing in the selection or distribution of controls. For example, if it should prove more difficult to detect a tilting in a longitudinal direction (pitch), it would seem advisable to compensate such natural inability of the aviator by facilitating the operation of the controls of pitch.

The principal results of a half year's work on six different individuals who participated in the experiment for one hour a week may be summarized somewhat as follows. The average efficiency for detection of roll (lateral) as contrasted with that for pitch (longitudinal) on a given hour were compared and thrown into per cents of superiority of the former. By greater efficiency is meant a quicker reaction time or a smaller angle through which one was turned before detecting the direction. By computing the probable error for a given set of measurements, it could be determined whether these per cents of difference were significant or due to mere chance. To give a general idea of the tendencies present, these per cents of superiority under various conditions of rate of motion were all averaged together. This average shows that the lateral tilting (roll) was detected approximately 25 per cent more readily than the longitudinal (pitch). There were a few exceptions, in which the perception of pitch was superior but the differences were slight, and such cases constituted only 14 per cent of the total number of experiments. The differences were, in general, three or four times the probable error of difference, i.e., approximately greater than could be attributed to chance.

In the above results no differentiation was made between backward and forward or between left and right, but merely one average determined for longitudinal and another for lateral motion. A further examination of the data shows that the detection of a forward pitch was easier than that of a backward. The results were not as marked as in the previous comparison, but, on the whole, the forward pitch was detected more readily in 72 per cent of the cases, with an average superiority (including the negative instances) of 19 per cent. Comparing the delicacy of perception of tilting to the left and to the right, the difference was so slight as to be insignificant—the figures tending in both directions with the average difference not more than 4 per cent.

GENERAL CONCLUSIONS

These results are what might be expected from theoretical considerations. In our daily life we are probably tipped more often in a sidewise direction than in a backward or forward. The rates of movement used in the above experiments were somewhat slower than those involved on an airplane. However, two different rates were used (one twice as rapid as the other) and in both cases the results were substantially the same—differing by only 3 per cent. In some supplementary trials the apparatus was modified to give a much more rapid motion. The wire ropes attached to the corners of the platform were hooked to short chains which passed over sprockets, each on the same shaft with a ratchet. A heavy spiral spring was inserted between these chains and the worm gear and crank. This spring could be placed under tension by turning the crank on one end while the ratchet held the other end securely. When the ratchet was released this tension pulled on the chain and wire rope, and the given corner of the platform descended very quickly a distance corresponding to the amount of tension placed on the spring. These conditions seemed quite analogous to conditions in an airplane, giving a quick motion with a negative acceleration.

The experiments in the near future are to be devoted to the problem of the relative psychological efficiency of the various standard types of airplane control. The reaction time to a sudden change of equilibrium will be measured with various forms of control, e.g., to a lateral tilting with a stick or wheel-ware as the reaction mechanism. A report of these experiments will be published when they are completed.

The outstanding results to date are that a change of equilibrium in a lateral direction (roll) is in general perceived considerably more readily than in a longitudinal direction (pitch), tilting forward is more readily perceived than tilting backward, but the difference is not as great as the preceding; and there is practically no difference in the ease of perception of a left as contrasted with a right roll.

The possible practical implication is that the aviator cannot detect a pitch of his machine as readily as a roll, and he will thus be slower in making the proper movements to correct the former. Hence in selection or arrangement of controls, if those for one direction are to be more readily manipulated or available, such should be those used for longitudinal control to compensate the aviator's natural slowness in detecting a tilting in that direction.

* A full technical account of the entire research will be published in one of the current psychological periodicals.

Course in Aerodynamics and Airplane Design*

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PART II—SECTION 4

Engine and Radiator Data

General Requirements of Aeronautical Engines

The main requirements of an airplane engine are light weight, low fuel and oil consumption, reliability, accessibility, and a form suitable for installation in an airplane. The general form, apart from its weight, is important because of the question of mounting in the body, and the problem of engine cooling and body stream-lining. Selecting an engine for an airplane means unfortunately buying the engine most nearly suitable which is purchasable at the moment, and the choice is none too great. Nevertheless it is part of a designer's training to consider the comparative merits of every engine available, mainly with reference to the above points.

As regards reliability, no rules can be laid down. Satisfactory tests in Government or college laboratories are good guides. The reputation which an engine has earned among pilots under the more trying conditions of actual flying is even more important. Accessibility depends not only on the design of the engine itself, but on its careful mounting in the body. Fuel and oil consumption, weight and suitability of form are best studied by the compilation of such a table as Table I. Such a table will require constant revision.

In considering weights of two engines of like power but of different type, such as a stationary air cooled and a water-cooled engine or a rotary air cooled engine and a stationary water-cooled engine, radiator and cooling water should not be neglected. In dealing with rotary engines, fuel and oil consumption tend to make comparisons with stationary engines less favorable to the former type than is at first apparent. Particularly is this the case when a flight of more than 2½ or 3 hours duration is contemplated. The extra weight of gasoline and oil to be carried for the rotary may actually make it the heavier engine at the beginning of a fairly long flight.

The form of an engine, from the points of view of mounting and projected area, are best studied from drawings appearing in technical magazines and makers' catalogs. The dimensions given in the table serve as a preliminary guide in narrowing down selection.

For a general study of the subject of aeronautical engines reference is appended to one or two excellent books—in which, however, no information as to recent developments is available.

The question of revolutions per minute apart from the question of power and efficiency in the engine itself has an important bearing on propeller design. Wooden propellers of large diameter seem to reach their maximum permissible safe speed at about 1300 r.p.m. Beyond this figure, it is hard to keep stresses down. Questions of direct drive and geared-down drives must be considered from this point of view.

Acknowledgment is made to Lieutenant H. C. Child, and to Mr. Lee S. Wallace for valuable data.

Weights for Radiators and Cooling Water

The following are good preliminary figures for design in accordance with general data:

Bare radiator	.55 lb. per bhp.
Water in radiator	.13 lb. per bhp.

The Ajax radiator employed in conjunction with a 130-hp. Hall Scott engine weighs 45 lb. bare and carries 30 lb. of water. On a school Curtiss of the JN type with a 90 hp. Curtiss engine, the figures for a Rome Turney radiator are:

Weight of empty radiator	58½ lb.
Weight of water contents	24¾ lb.
Thickness of core	2⅞ in.
Active front area	400 sq. in.
Total radiating surface	15 360 sq. in.

For the Livingston Radiator, the following information is available:

"For a 120 h.p. engine, from 16,000 to 18,000 sq. in. of radiator surface is required. Each square inch of projected area of 4 in. section contains 50 sq. in. of cooling surface. A 5 in. section contains 60 sq. in., and a 3 in. section contains 40 sq. in. Therefore, a radiator for a 125 h.p. engine will have between 320 sq. in. (2.2 sq. ft.) and 360 sq. in. (2.5 sq. ft.) projected area of 4 in. section. A radiator for such an engine contains approximately 4 gallons of water. Of this, 1 gallon is contained in the cells, the other 3 gallons in the headers. The headers should be of such proportions that the lower has about two thirds the capacity of the upper."

Practical Rules for Cooling Surface for Radiator of Honeycomb Type

From Dr. Hunsaker's experiments at the Massachusetts Institute of Technology and certain theoretical considerations, a surface of .83 sq. ft. per bhp. has been found necessary for the honeycomb type. C. Sage recommends 1.08 sq. ft. per bhp. for an airplane of an average speed of 60 m.p.h., and presumably a minimum speed of 45 m.p.h. An allowance of 1 sq. ft. per bhp. seems very fair for machines of medium speed. In fast machines of the pursuit type, it would be possible to go considerably below this figure, even if a fast machine makes a prolonged climb, it will not do so at its slowest speed. Dr. Hunsaker has shown that an empirical formula may be established of this type

$$a = \frac{C \times bhp.}{V}$$

where a = area of cooling surface, C is some constant and V is the speed in miles per hour. A designer, who has satisfactory data on a machine of a certain speed, can employ this rule for machines of a different speed.

Position and Resistance of a Radiator

Tests at the Massachusetts Institute of Technology show that the resistance of a radiator may be represented by the equation

$$R = K_x A V^2$$

where R = resistance in pounds
A = area of radiator face in square feet
V = speed in miles per hour
and K_x = .00175

While these tests were conducted on very small sections, the results are safely applicable to full-size radiators.

Figures on the resistance of a given section of radiator in a current of air do not by any means settle the problem of the best position for the radiator. Manufacturers have placed radiators in various positions, claiming minimum re-

* This Course commenced in the August 1, 1916, issue of AVIATION AND AERONAUTICAL ENGINEERING will be completed in 24 issues.

DATA FOR AMERICAN ENGINES

Maker and Model	No Cylinders	Type	Rated H P	R P M	R P M of Propeller	Gas per H P-hr in lb	Oil per H P-hr in lb	Weight Empty with Ignition and Carburetor lb	Weight Cooling Water in Radiator and Engine, lb	Weight of Example of Radiator lb	Weight Cooling Water in Radiator, lb	Weight of Example of Muffler lb	Weight of Example of Mounting, lb	Weight of Example of Cooling, lb	Bore in inches	Stroke in inches	Piston Displacement cu in	Overall Length in in	Overall Width in in	Overall Height in in	No Supporting Brackets	Fore and aft distance between Brackets	Athwartship distance between Brackets	Athwartship distance between Bolt Holes	Maker and Model
Aeromarine	6	Vert	85	1400	1150	7	069	440	37 5	31		8 12	28 2	5 5	$4\frac{1}{16}$	$5\frac{5}{8}$	449	58	30	$30\frac{3}{4}$					Aeromarine
Aeromarine D-12	12	V	160	1400				750										67	24	30	3				Aeromarine D-12
Aeromarine	8	V	100					410																	Aeromarine
Atwood C-12	12	V	150	2500	1250	64		592		63		13 25	55	40 9	$3\frac{1}{2}$	$4\frac{1}{2}$	519 5	48	27	26					Atwood C-12
Christofferson	6	Vert	113	1460	1450	665	0266	510		67 5		8 7	34	6 5	$4\frac{3}{4}$	6									Christofferson
"	8	V	160	2600				630	60	85		15	41	17 5											"
Curtiss-Ox 2	8	V	85	1400	1400			375		$58\frac{1}{4}$	$24\frac{3}{4}$				4	5	502	50	30	27	3	9		$12\frac{7}{8}$	Curtiss-Ox 2
" -OXX 2	8	V	100	1400	1400	59	035	423	44	76		12 25	23 2	10 6	$4\frac{1}{4}$	5	567 5	50	30	29	3	9		$12\frac{7}{8}$	" -OXX 2
" -VX	8	V	160	1400	1400	575	0328	645	62	86		16	45	12 2	5	7	1100	$67\frac{3}{8}$	35	34	5	9	14	16	" -VX
" -VX 3	8	V	200			73	031	667	70	94		16	14 7	12 2	5	7									" -VX 3
" -V-4	12	V	250			612		1127	100	120		24	60 1	19 6	5	7		$84\frac{5}{8}$	$34\frac{1}{2}$	40					" -V-4
Duesenberg	4	Vert	140	2100				455				7 21	29 5	4 8	$4\frac{3}{8}$	7	496	$43\frac{3}{8}$	$15\frac{1}{2}$	$37\frac{3}{8}$	4	$13\frac{5}{8}$	$13\frac{5}{8}$	$14\frac{1}{4}$	Duesenberg
"	12	V	250	1800				425				15 5	49 2	18	$4\frac{3}{8}$	7	1488	68	$31\frac{1}{4}$	$39\frac{5}{8}$	4	$15\frac{3}{8}$	14	$15\frac{1}{2}$	"
Geal Ordnance Co	8	V	250	1800				867							$4\frac{3}{4}$	$6\frac{1}{2}$	920								Geal Ordnance Co
Geal Vehicle Gnome	9	Roty	100	1200		72		272							4 33	$6\frac{1}{2}$	920								Geal Vehicle Gnome
Gyro K	7	Roty	00	1250		545	166	242					22 7	12 4	$4\frac{1}{2}$	6									Gyro K
" L	6	Roty	100	1200		614	180	285					24 4	13 2	$4\frac{1}{2}$	6	859	24 7	$37\frac{1}{2}$	$37\frac{1}{2}$					" L
Hall-Scott A-7	4	Vert	80-90	1370	1370	47	037	410	44*	40			28 9	4 5	5	7	550	57	$18\frac{1}{2}$	$36\frac{1}{2}$	4	$16\frac{1}{4}$	14	16	Hall-Scott A-7
" A-5	6	Vert	125	1300	1300	507	028	592	52*	45	30		39 6	6 8	5	7	825	$63\frac{3}{4}$	$18\frac{1}{2}$	$41\frac{1}{4}$	3	$35\frac{1}{4}$	14	16	" A-5
" A-5a†	6	Vert	162	1325		14 7‡	4‡	562																	" A-5a†
Hispano-Suiza	8	V	154	1500				455		48 3		10	13 5	28 3	$4\frac{3}{8}$	6	672	$52\frac{1}{2}$	$32\frac{1}{2}$	$35\frac{1}{2}$	$12\frac{1}{4}$	$14\frac{3}{8}$			Hispano-Suiza
Knox	12	V	300	1800				1425				19 4	56 9	21	$4\frac{3}{4}$	7	1555								Knox
Packard	12	V	225	2100				800							4	6	905	$62\frac{3}{4}$	$23\frac{1}{16}$	$41\frac{1}{2}$	3		$16\frac{1}{4}$	$18\frac{1}{4}$	Packard
Rausenberger C-12	12	V	150	1700				570							$4\frac{1}{8}$	6	900	42	24						Rausenberger C-12
Sturtevant 5	8	V	140	2000		54	043	600	70	60	40		30	30	4	$5\frac{1}{2}$	522	$59\frac{1}{16}$	23	$29\frac{1}{16}$	3	$14\frac{1}{16}$		$13\frac{3}{4}$	Sturtevant 5
" 5-A	8	V	140	2000	1200			514	66	54	40				4	$5\frac{1}{2}$	522	$59\frac{1}{16}$	34	$34\frac{1}{16}$	3	$14\frac{1}{16}$			" 5-A
"	12	V	275	2000											4	$5\frac{1}{2}$									
Thomas 8	8	V	135	2000	1200	59	053	572	80	100		15 3	40 1	13 6	4	$5\frac{1}{2}$	552 9	60	28	$37\frac{7}{8}$	3	$13\frac{1}{16}$		$13\frac{3}{4}$	Thomas 8
" 88	8	V	150	2000		59		485													3	$13\frac{1}{16}$		$13\frac{3}{4}$	88
Wisconsin	6	Vert	140	1380	1380	550	027	637	38*	60	25				5	$5\frac{1}{2}$	765 7	$17\frac{1}{4}$	24	$41\frac{1}{16}$	4	$14\frac{1}{2}$	$13\frac{3}{4}$	$16\frac{1}{2}$	Wisconsin
"	12	V	250	1200	1200	602	029	1000		142		19 1	54 2	10 8	5	$6\frac{1}{2}$	1532	$76\frac{1}{16}$	$37\frac{1}{2}$	$37\frac{1}{16}$	4	$14\frac{3}{4}$	$15\frac{1}{2}$	$18\frac{1}{2}$	
Wright	6	Vert	60	1400		545		306		39		6 25	25 9	6 4	$4\frac{3}{8}$	$4\frac{1}{2}$									Wright

* Engine only
† Figures obtained from test run
‡ Gallons per hour

sistance for each position. If a radiator is placed behind the propeller where the slip stream increases the velocity by some 25 per cent, the cooling surface may be decreased by 25 per cent with a consequent reduction of resistance producing area, but since the resistance varies as the square of the velocity, there is finally an increase of 25 per cent. These or similar considerations have led designers to place radiators underneath the wings. But it is forgotten that when a radiator is placed underneath the wings, it is no longer a shelter for the body. There is also the question of extra length of piping. For radiators placed at the sides, Dr. Hunsaker's opinion is that a more generous allowance is necessary. Dr. Zahm's skin friction formula is of the form $R = 0.0000158\ l^{.93}\ V^{1.85}$, as we saw in Part 1, Section 3, AVIATION AND AERONAUTICAL ENGINEERING, Sept. 1, 1916, p. 88, where l is the length of surface parallel to the wind. Owing to the greater length of side radiators in the direction of motion, they are therefore probably less effective.

The authors' opinion is that the best and most natural position of the radiator is behind the propeller, but the question is hardly capable of a decision so far.

Practical Construction of Radiators

C. Sage, engineer of the Rome-Turney Radiator Company, has submitted the following authoritative views:

"As to the construction of radiators, we may say that the simpler the outline the more durable will be the radiator—and the cheaper. The cooling section of honeycomb radiators ought to have outlines composed entirely of straight lines—curves in the honeycomb core are expensive and are weak points for the reason that all honeycomb cooling sections are cut the start made of rectangular blocks and then sawed to shape on a band saw like a board. The sawed-off waterways have then to be patched up again with solder and their ends are naturally not as strong as before. Then this section has to be fitted to the case and the more curves there are the more difficult and costly the fitting will be. Concerning the case of the radiator the same principle holds good—the simpler the design the better and cheaper the product. All curved surfaces are costly if they have to be produced by hand work and pressed cases must be made in large quantities in order to pay for the necessary punches and dies and it takes a long time until production can be started on them.

"As for water connections between engine to radiator and pump to radiator, it is very important that they be large enough to convey the large bulk of water with the least possible pressure. If the connections are too small a considerable vacuum will be set up in the suction line from the radiator to the pump and consequently air will be drawn into the water at all leaky points, prominent among these being the stuffing box and the grease cups of the pump. This air will be mixed with the water forming a milky liquid like churned water, increasing its volume, and consequently a considerable loss through the vent pipe will take place.

"As to support of a radiator the most satisfactory method is the use of a cradle or cross plate at the front of the body. In the case of a tractor on which the radiator is placed and fastened to a cradle in the bottom tank. In the case of pushers, many different suspension methods are used, none of which can be called standard and the same is true for side radiators."

An excellent point made by the manufacturers of the Ajax radiator is the reinforcement of the tubes near and about by soldering on 1/16 in. wires. Dividing a radiator into two parts by a small ¾ in. deep water tank to permit refilling of the water, is another good point in this type.

As a general rule, the subdivision of a radiator into a number of sections is advantageous. In the present ill-defined position of radiator design, it is an advantage to be able to increase or diminish the radiator surface of a given machine.

References for Part II, Section 4

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Notes on Radiator Design ... Hunsaker ... Mar. 29, 1916.

Aircraft Engines ... Franklin ...

Internal Combustion ... ... Wimperis ...

... Aeronautical Engines ... ... Toulmin ... An ... Report of the National Advisory Committee for Aeronautics.

These reproductions of four French and one Belgian postage stamps used by six flying squadrons of the Allied armies on the Western front in Europe were made from originals in the collection of Dr. J. Darwin Nagel of New York.

These stamps are printed in various colors and are used by authority of the three governments for home correspondence by the aviators and others attached to the flying corps.

America's Aeronautic Needs and Possibilities

By Dr. Charles D. Walcott

Chairman of the National Advisory Committee for Aeronautics

Congress has generously responded this year with large appropriations with which to establish air fleets for both the Army and Navy and yet a careful review of results accomplished thus far clearly indicates that with the passing of the first year of our active aerial program we have made a beginning.

The aeronautic industry's inability to meet the needs of the government is in itself only another example of the fact that though millions may be available for a specific purpose, in time of great need no amount of money will buy time. Even the most generous appropriations do not open up the years that have passed and could not be so carefully used. The foundations of a great industry and a great aerial arm through the education of engineers, manufacturers, teachers and all of the wide variety of personnel required. An aeronautical engineer for instance does not step full fledged into being but is the result of years of patient study of and experience with aircraft. Such an evolution can only be accomplished with time.

Government Support Required

The aeronautic industry requires governmental support in its development and this it has not received in the past in this country in a measure sufficient to enable it to meet the present enormous demands that have suddenly been made upon it. During the eight years prior to 1916 the army ordered 59 airplanes and received 54. These were all supplied by four makers and the largest number ordered from any one maker was 22 machines—not a very large amount of encouragement over a period of eight years.

During 1916 the army ordered 366 planes and received 64. These planes were divided up among nine factories which factories represented practically the entire producing capacity of the country. Whatever the industry may produce during 1917 is bound to fall far short of the country's needs and our object now is to ascertain how the situation may be helped.

The urge of a life and death struggle in Europe in which command of the air is of importance has stimulated the aeronautical industry over there into a tremendous development. New models succeed new models in rapid succession in the feverish race for the air supremacy and only the most perfect and up-to-the-minute aircraft are permitted to reach the fighting lines.

The potential fighting strength of this country if properly trained and equipped is greater than that of any of the European countries with the possible exception of Russia. We are enormously wealthy as a nation with a tremendous consti[tuency] to protect. Whatever else in the line of preparedness we may excuse delay in, we must not permit anything to stand in the way of the upbuilding of our aerial defense. It is not impossible to believe that a good navy supplemented by an adequate aerial organization and equipment to maintain command of the air would go a long way in an emergency toward making up for an inadequate or imperfectly trained fighting force on land.

Military Types of Airplanes Needed

We want all types of planes in large quantities for training, reconnaissance, bomb dropping, fighting, etc., for both Army and Navy use. We want them as good as or better than, the best European types. We want the skilled aviators in equally large quantities to handle these various fighting machines and we want the whole program completed at the earliest possible date.

At the present time there are not more than twelve airplane manufacturing organizations in the United States with the necessary engineering and manufacturing experience and facilities to justify government business. The first conclusion to be arrived at is therefore that these factories must be encouraged to expand as rapidly as possible to reach a capacity of planes per year that might be considered as our reasonable needs.

There are many estimates of our reasonable needs and the one presented in Table 1 has been prepared after conferences with as many men as could be reached who have experience or judgment qualifying them to express an opinion and after obtaining as much data as possible from Europe.

Wastage in Training Aviators

The last item, of training machines is

TABLE 1

TENTATIVE ESTIMATE OF ANNUAL REQUIREMENTS OF AIRPLANES (ASSUMED TO BE POSSIBLE OF ACCOMPLISHMENT IN 1919)*

Attached to an army of 1 000 000 men, that is one plane per 1 000 men	1 000 planes and	1 000 aviators
Attached to our fleets at sea	200	200
For harbor and seaport defense	800	800
	2 000	2,000
For training pilots (planes worn out or broken)	2 000	400
	4 000	2 400

* In war time each plane in the air would need three in reserve besides one broken up training the pilot.

arrived at as follows: It has been found best to divide the students into assignments of five per instructor. European experience shows that it takes at least nine months to produce a properly trained advanced military aviator and that it costs approximately one and one half machines in wear and tear and breakage for each finished aviator. The breakages are most often made by the men who fail to qualify. Assuming that it would be desirable for many reasons to limit each military aviator's active duty exclusive of war time to one year then we must each year produce 2 000 new aviators. Disregarding failures, 400 instructors should each turn out five finished advanced military aviators each with a minimum of nine months instruction. It is probable that the longer the time allowed and the more careful the instruction the lower would be the percentage of planes used up per aviator. Instead of one and one-half planes per aviator we have figured only one, or at the rate of 2 000 planes per year to produce the 2 000 finished fighting pilots.

If we assume that the above figures are approximately correct then an industry that delivered to the Army and Navy less than 100 machines during the eight years prior to 1916, less than 100 machines during 1916 and which will deliver somewhere around 800 planes during 1917 has still to be very greatly expanded in order to reach what may be considered the reasonable requirements of the country.

To facilitate this necessary increase of output without the opportunity at the moment of increasing the number of different sources of supply demands the closest co-operation between the Army, the Navy and the industry in order to eliminate every stroke of unnecessary effort and in order to concentrate all activities upon the fewest number of types and designs of each that will completely meet our needs.

Standardization of Airplane Types

It is entirely unnecessary, for instance, to have five companies all producing a different design of training machine to do the same work. One of the five is best, and when determined should be made the standard until a better is developed.

Again with so few sources of supply it is imperative in the interest of efficiency not to have every manufacturer producing every type but for instance to allot all of the types where they can be best produced. In this way each factory will concentrate on the one or two types that it knows most about and will have volume enough to make for more economical operation and better prices. This should greatly stimulate improvement of types for not only would a large amount of duplicate designing be avoided but each engineering staff would be concentrating all its efforts on some particular part of the government program that had been assigned to it.

It is highly desirable at this time that there should be a very active campaign carried on in the standardization of the more common parts and fittings of planes and engines so that when we may have arrived at such an output as 4 000 planes per year there shall be the greatest degree of interchangeability of those parts and fittings in the interest of prompt field repairs. It is also important that all of the materials themselves should have standard specifications acceptable to Army and Navy alike.

Inspection Reforms

Much can and should be accomplished in reconciling the many differences that exist between the inspection systems of the Army and Navy as affecting aircraft. There is room for some simplification, for the removal of some duplication of effort between the departments and between them and the manufacturers and for a standardization of practice. Considering the rapid increase in output that must be made during the next two years, it is important that this problem be intelligently handled now.

In order to successfully speed up production plans will have to be laid at once and steps taken preferably by the government to provide in advance the actual need the different kinds of material that are hard to obtain but which must be available in large quantities. For instance if the industry is to produce 2,500 planes during 1918 and 4 000 during

1919, then there should be about two and a half million feet of spruce air drying right now for next year, and we should be laying down four million feet to take care of the year after. There are about five or six items of this kind that it is decidedly to the government's interest to handle promptly in order to ensure an adequate supply at the right time and at the right price.

Patent Situation

From the standpoint of our national defense it is imperative that patent matters be not allowed to impede this very vital industrial growth. Congress recently appropriated one million dollars for the purpose of acquiring by purchase condemnation, donation or otherwise any basic patent or patents that may be necessary to the development of the industry. It is not the desire of the National Advisory Committee on Aeronautics in whose hands the matter rests at the moment for recommendation, to condemn or purchase any patent. It believes that such action would be construed as indicating an unreasonable attitude of mind on the part of the owners of the patents condemned or purchased—besides perhaps serving to discourage invention, if the settlement was made on too low a basis or to encourage all sorts of claims upon the industry and the government, if such settlement was on too high a basis. The committee is therefore working diligently upon the proposition of arranging an adjustment out of court, whereby just recognition will be made to the owners of the more important or basic patents in the form of reasonable royalties to be paid by the purchasers of planes whether for military or civil use.

Some difficulty has been experienced at times through inability to secure tests of finished planes. The present requirements that every machine produced be tested against its specifications sometimes works a hardship on the manufacturer who must keep his product moving and his capital turning over, when a long spell of bad weather precludes test flying. This situation will probably grow much worse instead of better as the result of a rapid expansion of the industry and calls for careful consideration and some revision of the present arrangements in order to still arrive at the same result without inconvenience or handicap to the industry. The government must of necessity surround the disbursement of public funds with ample safeguards but it cannot afford to impose unnecessary burdens upon the rapidly growing aircraft industry.

One of the really serious problems is the matter of obtaining enough competent instructor aviators to teach the very large number of young men who are applying for commissions in the Officers Reserve Corps, Aviation Section. It is apparently going to be just as serious a matter to build up an adequate force of teachers of the advanced science of military flying as now practised abroad as it is to produce the machines that are to be flown.

The Safe and Useful Airplane*

An Interview with
Orville Wright

When I recently talked with Orville Wright on the airplane I found him more interested in its usefulness as an instrument of peace than as an instrument of war.

"I really believe," he said, "that the airplane will help peace in more ways than one—in particular I think it will have a tendency to make war impossible. Indeed it is my conviction that, had the European governments foreseen the part which the airplane was to play, especially in reducing all their strategical plans to a devastating deadlock, they would never have entered upon the war. Possibly they foresaw something of the present development, but not definitely. When I was in England several years ago I found the British Government not at all enthusiastic about the airplane since the English military experts regarded it as a menace to England's isolation. This was the time when the nation was aroused over the fear of a German invasion. There was a widespread belief that the Germans were planning a descent in several forms of aircraft, and many very sensible people regarded such an enterprise as not impossible. Naturally they looked with suspicion upon any instrument such as the airplane which might facilitate such an operation. This illustrates the mistaken notions which were entertained concerning the practical uses of the airplane in warfare. Most of us saw its use for scouting purposes, but few foresaw that it would usher in an entirely new form of warfare. As a result of its activities every opposing general knows precisely the strength of his enemy and precisely what he is going to do. Thus surprise attacks which for thousands of years have determined the event of wars are no longer possible and thus all future wars between forces which stand anywhere near an equality will settle down to tedious deadlocks. Civilized countries knowing this in advance will hesitate before taking up arms—a fact which makes me believe that the airplane, far more than Hague conferences and Leagues to enforce peace, will exert a powerful influence in putting an end to war."

"I presume you would welcome such an outcome?" I said.

The Airplane in Peace

"Yes indeed," answered Mr. Wright quickly. "I should hail this as the airplane's greatest triumph. My main interest is in the airplane as a real promoter of civilization. Recent events have made us regard it almost exclusively as a weapon of war. Probably many people believe that as soon as peace is signed the thousands of airplanes that have contributed so greatly to it will be scrapped. That is not my belief. After the war we are told we shall have a new world and a new type of civilization. In my opinion one of the factors that will contribute to this changed order will be the part which will be played in it by the airplane. We shall have an entirely new form of transportation which will serve many ends and contribute in many ways to the welfare and happiness of mankind."

"Yes," I remarked, "we have many prophets who tell us of the wonderful future in store for your invention."

Extravagant Ideas Are Afloat

"Yet I am not one of those," answered Mr. Wright, "who entertain extravagant ideas concerning its future. All sorts of ridiculous notions are afloat, largely fathered by people of lively imagination and of limited information. I do not believe that all transportation in future will be through the air. The airplane will not supplant the railroad, the trolley car, or the automobile. All our present methods of transporting passengers and freight will continue to render excellent service. The airplane will merely be an added agency for performing a similar kind of work. There are certain things that it will do better than the railroad or the automobile and its use will therefore be limited to these, for we must realize at the start that the airplane has decided limitations. In saying this I am discussing the machine as we know it today. It is not impossible that other forms of aircraft built upon other principles may be invented which may accomplish all the wonderful things certain imaginative people prophesy for the present airplane. We see numerous pictures today of aircraft as large as ocean liners, but these are merely idle imaginings. We shall have no airplanes as large as the Lusitania. Any one who understands the fundamentals of air mechanics will immediately understand why this is so. The airplane is built essentially upon the same principles as a bird; it has the same flying capabilities as a bird and precisely the same limitations. The best flyer among birds is the humming bird. Have you ever noticed how it poises itself in the air in almost identically the same place perhaps for an hour at a time? The humming bird is one of the smallest of birds, and certain insects which are much smaller, such as the dragon fly, are also wonderful flyers. It is a law of nature that the larger the bird the poorer its flying ability. The barnyard fowl has great difficulty in getting over a fence, while the ostrich does not fly at all. All creatures that live in the air are small; we have nothing among flying animals which can be compared in size to the horse or the elephant. There are excellent mechanical reasons for this. The main one is that as a bird increases in size its weight increases at a much greater rate than the area of its wings. Thus if a bird doubles in size, it would need to lift itself in the air not twice as much power but eight times as much. That is, the weight increases as its cube whereas the area of the wings increases as its square.

"You can readily see where that mathematical principle will soon lead you. This is the principle that limits the size of birds and it is also the principle that limits the size of airplanes, which fly just as birds fly. Each increase in size demands a much greater proportional increase in motive power, the result being that we have to add so enormously to the weight that the airplane soon reaches a size where it cannot leave the ground. Many attempts have been made to make bigger machines but nothing is gained in economy or usefulness by making them. The airplane is a method of transportation that works best and most inexpensively in small units. We can get better and cheaper service out of two airplanes of moderate size than we can get out of one which is twice as large.

* By Burton J. Hendrick in Harper's Magazine for April.

There are other factors that will limit our present airplane practically to its present size but it is unnecessary to go into the matter in greater detail. Ten passengers have already been carried comfortably, yet it is a fact that a large car carrying ten passengers would not be so economical or efficient as ten little cars each carrying one."

"Most people believe," I suggested, "that what mainly stands in the way of the airplane is its danger. The average citizen regards it as an exhilarating and exciting sport but not safe enough for general use."

Airplane Is Safe in Safe Hands

"Yes," said Mr. Wright, "it is a new idea that the airplane is a safe means of transportation in safe hands and it is an idea that we must slowly get into the popular mind. The average citizen is still frightened at the prospect of leaving the ground and having no support except the air itself. Yet at the speed which we expect an airplane to maintain—seventy or eighty miles an hour—there is no means of transportation that is so safe. The obstructions that cause accidents with trains and automobiles do not exist for flying craft. A locomotive has to follow a definite track which may be obstructed or the slightest dislocation of which may cause a frightful calamity. The airplane is not so circumscribed—it travels anywhere it wishes to go. There are no obstructions in the air—unless we regard 'air pockets' as such—no bridges to cross, no mountains to penetrate, no signals to run by and no switches to be misplaced. Or compare this new craft to the rough road of the automobile. The slightest mistake or even inattention on the part of the driver going say forty or fifty miles an hour may hurl the machine over a precipice or overturn it on an embankment. But such a lapse on the part of an aviator has no such deplorable results: there are no precipices to fall from and no obstructions to collide with. The airplane is even safer than some forms of water travel. The motorboat, going at a speed of forty miles an hour or even slower, is a more risky form of transportation than an airplane. If such a boat strike even a small obstruction such as a floating plank its side is punctured and it sinks in a few seconds. But there are no such dangers in the air.

"Certain performers have done much to instil this notion that flying is exceedingly dangerous," Mr. Wright continued. "These are the daredevil exhibition flyers, who cultivate the circus aspects of the art. Both by words and deeds they have associated the airplane with the idea of danger. They have spread abroad the impression that only an immense amount of nerve, abnormal skill and plenty of luck qualify one for aviation. And their air acrobatics, their tail glides and their loopings the loop—have accentuated this idea. They have had many bad accidents, too, which have been the necessary consequences of inexperience and of taking foolish chances. Yet I do not wish to criticize too harshly these circus performers, for they have accomplished much good. The man who first looped-the-loop made a solid contribution to the sum of aeronautics, for he demonstrated the wonderful stability and righting power of the airplane. He showed that the contrivance could get into practically no position in the air from which it could not be righted. What other means of transportation except the airplane, sails just as well upside down? In what other can one turn turtle without fear of serious consequences? We owe the demonstration of these reassuring facts to the exhibition performers and the discovery has the greatest value for the man or woman who prefers to fly in a more prosaic fashion. It gives them a consciousness that, whatever happens, they are safe. Still these flyers, with their numerous accidents, have made the aviator's career seem a hazardous one and of this false idea we should disabuse our minds. There is no sense of dizziness in the air. Once well up, you never know whether your elevation is a few hundred or a few thousand feet."

"Are there, then, no dangers in flying?" I asked.

The Only Danger Is in Landing

"Yes indeed," Mr. Wright answered, "but there are no difficulties which ordinary prudence and common sense cannot provide against. For the greatest danger of aviation is not the flying but the landing. If one has a wide smooth open space under us, everything goes well; if we do not, the consequences are unpleasant. If we are only a hundred feet in the air, we haven't time to select a landing place but go down just where we are, whether it is a deep pond, a mass of telegraph wires, or the tangled roofs of the city. If we are up a thousand or more feet, however, we have much more room to glide in and can usually select some place where we can land in comfort. The usual gliding range is about eight to one, that is, if the airplane is a hundred feet in the air it lands about eight hundred feet away from the place where the motor stops, while if it is up a thousand feet, it comes down about eight thousand feet away, or about a mile and a half. A height of two thousand feet, giving a gliding range of three miles, is usually safe for all purposes as from this height, the flier can discover a level spot within that large radius. Thus safety in the air is almost entirely a matter of maintaining a sufficient height. Exhibition performers constantly take this risk; they persist in flying low over a city, taking their chances that the engine will not stop. I cannot understand why men will run such risks, unless it is that flight itself is so easy, and the airplane inspires such confidence, that the possibility of a mishap vanishes from the mind."

The First Wright Airplane at Kitty Hawk, N. C., with Orville Wright

"What do you do, then, when the engine stops?" I asked.

"The stopping of the engine is not in itself dangerous," said Mr. Wright; "it merely means a descent to earth until the mechanism can be again made ready for flight. But it is inconvenient, and a deterrent to commercial flying. An engine that works with the same perfection as the automobile engine is to-day our greatest need. And we are making rapid progress toward obtaining it. This, it will be remembered, was the greatest problem of the automobile in the early days—the engine's constant tendency to break down in a distant road was a constant irritation. We have been going through this same preliminary stage with the airplane engine; indeed I think we have made more progress in the same period of time in propelling the flying-machine than we did in propelling the automobile. American manufacturers are somewhat behind Europeans in making engines, simply because we have not had the opportunities to experiment. Making thousands of machines for war purposes the European manufacturers have naturally produced engines that are superior to ours. They have spent millions in experimental work and with satisfactory results."

"What then will be the commercial and pleasure uses of the airplane? Will it carry passengers to any extent?"

place for his descent all is well, but it is inconvenient and it may be fatal to land in the top of a tree or somewhere in the neighborhood of a sky scraper. Of actual upsetting in the air—that is, a genuine fall such as was not infrequent in the early days—there is now very little danger and there is no reason why accidents of this kind should ever take place, for, as I have already said, an airplane, no matter what position it gets into, is easily righted. What we must guard against, above everything, is flying too near the ground. Here again we must revise the popular attitude toward the airplane. Most people feel that they would not mind going up provided they went up only a hundred feet or so; the idea of ascending fifteen hundred or two thousand is what appals them. But in general I may say that the higher one flies the safer he is. Clearly, if you are going to fall you will suffer no more by falling from a thousand feet than from five hundred; the chances are that you will be killed in either case. But you are less likely to have a serious fall at the higher altitude than at the lower. The reason is that if the machine is high enough, the pilot has space in which to right himself, while if he is too near the ground he does not have sufficient space.

"We also hear much about the stopping of the engine. The public has the impression that this dead engine is one of the greatest perils of flying. As a matter of fact the stopping of the engine is not necessarily a serious matter. The engine does not make the airplane fly—it merely propels it. The machine flies when the engine stops, only it does not fly on the horizontal plane. Whenever this happens it glides easily and gracefully toward the earth. If we have a level landing place

Airplanes Make for Speedy Transportation

"Yes. It will not, as I have said, supplant the railroad, but there are certain things that the airplane can do better than the railroad. It will be demanded whenever the necessity is for great speed. Few express trains average more than fifty miles an hour—though they make greater speed on short stretches of straight track—whereas that speed represents almost the minimum of the flying machine. We think nothing of sixty and seventy miles; a regulation speed of one hundred miles may be expected, and, as said above, certain pursuit airplanes now used in the war go at the rate of one hundred and twenty five miles an hour. At first, even the suggestion of such speeds almost takes one's breath away. It seems inconceivable that human beings could physically endure such rapid traveling. But there is one great difference in traveling in the air and on the surface. On a railroad car we are always conscious of high speed, well up in the air we are not conscious of it at all. The sensation is precisely the same whether you are going forty or ninety miles an hour, or, indeed, if you are making no progress at all, as, in a high adverse wind, sometimes happens. A speed of one hundred miles an hour, therefore causes no physical distress. Traveling under such circumstances will be far pleasanter than that furnished by the most luxurious Pullman or automobile. There is no roadbed to jar and we never know when we are going around a curve. Indeed, the passengers will hardly realize that they are moving at all."

"How will this cut down the time of traveling?"

Airplanes Will Supplant Special Trains

"The trip from New York to Boston," Mr. Wright answered, "would take about two hours, where now it takes five. From New York to Chicago will take eight or ten hours instead of twenty, as at present. You will be able to make the trip from New York to San Francisco in a couple of days. Now plenty of occasions arise in everyday life when such rapid transit is desirable. The only recourse now for unusually rapid speed is the special train. This has two disadvantages—it cost so much that only railroad presidents and millionaires can use it, and after all, it does not go very much faster than the regular train. In a very few years, I think, the flying machine will do all the work that the special train does now. It is not only faster, but it is more comfortable, much safer, and much less expensive. The New York business man who wishes quick transit to Chicago, where the saving of a few hours will perhaps mean a successful business deal involving millions, will use the airplane. So will the man who wishes to reach the bedside of a sick relative, where saving an hour or two may mean seeing his wife or child alive. We frequently read of surgeons being rushed upon a special train so that they may arrive in time to perform an operation that may save a human life. What a godsend the speedier transit of a flying machine will be in cases like this!"

"Why isn't such a service established at once?" The question was a natural one.

"Chiefly because of the impediment I have mentioned—the scarcity of good landing-places. It will be necessary to establish such landing places—that is, smooth, level fields—at all important points. We have two or three such model landing-places already—especially those at Dayton and at Detroit. All large cities will have to build such accommodations; future municipal planning will necessarily provide them. With these established in all important points, the day of passenger traffic will begin. This service can supplement the regular railroad in numerous ways. In particular it will make 'missing the train' much less of a calamity than it is now. Suppose, for example, you fail to catch the Twentieth Century Limited at the Grand Central Station, you can jump into an airplane and reach Albany in plenty of time to catch it there. Perhaps the greatest service of the passenger airplane is that it will make accessible parts of the world that are now little used. There are plenty of places where railroads cannot be built because of the great cost, because of engineering obstacles, and because there is not enough traffic to justify them.

Present Airplane Not for Freight

"This brings me to the use of the airplane for transporting freight. The present type of machine will never supplant the freight car, and I cannot foresee that it will ever be used for carrying coal or wheat. But in transporting special small packages, precious freight, it will be extremely useful. Here again we shall penetrate sections where the railroad cannot carry us. There are thousands of such places in the West, in South America, in Africa. The airplane will probably be one of the most potent agencies in the development of Alaska, for here we have an extremely rich country where railroads are difficult and extremely expensive to build. I can best illustrate this by a special instance. There is a certain port in Alaska back of which about sixteen miles away, lie rich gold-fields. The problem of the company which works these mines is to get supplies to its men and to get the concentrate back to tidewater. The mines are shut off from the port by two ranges of mountains four thousand feet high, and it is inconceivable that a railroad should ever be built across these obstructions. Supplies are now sent by a circuitous route which takes three days to make in the summer time, in winter it cannot be made at all. The company is now completing plans to install an airplane service. In this way the workmen can easily sail over the mountainous barriers and reach the miners in an hour. They can thus carry supplies to the workmen and bring back the concentrate. The money saved will be an important item, the great point however, is that the mines with all their precious output can be successfully worked for the first time. There are thousands of places in Alaska and elsewhere, where precisely the same situation exists. In such places the flying machine will perform much work now done by packhorse and mule and open up sections where even the mule is useless for transit purposes. One of the greatest obstacles to transportation in Alaska are certain large areas of 'nigger heads'—flat stretches resembling swamps, with a growth similar to cabbage heads which neither man nor beast can negotiate, and across which neither railroads nor highways can be built. These obstructions, of course, will present no difficulty to the airplane."

"Will the airplane be useful for carrying mails?"

Airplanes as Mail Carriers

"Not to the extent that some people suppose," said Mr. Wright. "I do not think it will supplant the steamship and the railroad as a mail-carrier, because it will be too expensive. It would take a very large number of flying machines, perhaps a hundred, to carry as much mail as we now get into a mail car. You can easily figure how this would increase the expense. It will have the same advantage in carrying mails as in carrying passengers, and that is speed. This statement also needs some qualification, for, when it comes to quick communication, the airplane can never supplant the telegraph and the telephone. But we shall probably have a special rapid mail service by airplane, for which we shall pay a higher price and buy a special stamp. The flying machine will give a ten hour service between New York and Chicago and a two-day service from the Atlantic to the Pacific. It will likewise carry letters into remote sections which the mail now reaches only at long intervals or does not reach at all. The United States still has a large number of 'star routes'—routes which the mail-carrier travels on horseback, sometimes consuming days in the journey. The airplane can do all this work much more cheaply and much quicker. It goes in a straight line, whereas the star route man has usually to take a roundabout course, for the machine has no obstacles.

"In Mexico we have had an example of the use of the airplane for carrying mails. Practically all the mails from Columbus, New Mexico, to Pershing's column have been carried by air.

"Airplanes in Mexico also carried extra officers from one headquarters to another and important personal matter and express between the two bases."

"But how about the airplane for sport?" I asked.

The Sport of Flying

"I think," Mr. Wright replied, "that it is the greatest sport yet devised. It is far more exhilarating and delightful than the automobile for high speed and far safer. The time is not far distant when people will take their Sunday afternoon spins in their airplanes precisely as they do now in their automobiles. Long tours in the air will offer greater relaxations from the daily grind than long railway journeys. People need only recover from the foolish impression that it is a dangerous sport, instead of being, when adopted by rational persons, one of the safest. It is also far more comfortable. The driver of an automobile, even under the most favorable circumstances, lives at a constant nerve tension. He must keep always on the lookout for obstructions in the road, for other automobiles, and for sudden emergencies. A long drive is therefore likely to be an exhausting operation. Now the airplane has a great future for sporting purposes because this element of nerve tension is absent. The driver enjoys the proceeding as much as his passengers and probably more. He can make mistakes, even lapse in his attention, without any serious consequences. While no longer favoring the amateur, many of my readers will remember that ten years ago my brother and I carefully selected the days in which we made our flights. Some days when there was too much wind we would not fly at all. But we have learned now how to fly, and even strong gales do not now frighten the flier. He goes up except in the very bad days. The only climatic conditions that deter him now are the kind known as 'cyclonic,' when there are great twists in the atmosphere. Under these circumstances he does not fly."

Two Types of Monster Aircraft

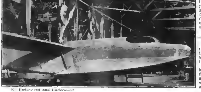
The photographs on this page show two views each of two types of large size airplanes. The top pictures give some idea of the magnitude of the giant flying boat which the United States Navy has purchased from the Curtiss Aeroplane Company. This machine has 92 ft. 8½ in. spread on the top wing, to which alone ailerons are attached. The height is 16 ft. 9½ in. and the length overall is 46 ft. 5½ in. The machine weighs 5945 lb. on the floor of the Curtiss factory and is built to carry a ton and a half of gasoline, oil, instruments, passengers, armament and other useful load.

The two Curtiss VX-3 200 hp. engines are expected to drive the boat at a high speed of 85 miles an hour.

Twenty flying boats of similar size are said to be under construction at the Curtiss Buffalo plant for the Royal Naval Air Service of Great Britain.

The flying boat's wings are braced by nine pairs of wood struts, vertical wood struts supporting the center section instead of the conventional inverted V-type of support used in the Handley Page land machine shown at the bottom of the page

Photo Bain News Service



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which has recently been built in Great Britain. The wing floats of the Curtiss flying boat, which is known as model H 13, are of a simple and efficient form. The boat body embodies many novelties of design. It is of the V type with fins forward. There is no step.

The giant Handley Page machine shown in the two views at the bottom of the page is one of the most recent English designs. No accurate details are available in regard to its size or performance. The controls are interesting. The wings are built with a dihedral of about 4 degrees and the ailerons are balanced. Four rudders are used for steering and there are four elevating surfaces.

An idea of the size of the machine can be gained by a comparison with the men standing at the side of and in front of the airplane. While only two pairs of struts are used on either side of the center section the spread would appear to be comparable with the spread of the Curtiss H 12 boat. The engines are used to turn four bladed propellers. The tail skid is distinctly unusual and is said to be equipped with a claw brake. The landing gear also is worthy of close attention.

Courtesy of "Flight"

Courtesy of "Flight"

"Tex" Millman Dead of Pneumonia

Peter C. Millman, student instructor at the Mineola flying school died at his home, Hempstead, Long Island, on Sunday, March 18, 1917 from pneumonia. He was twenty-two years of age.

Peter Carl Millman was one of the best known pilots in the east. He learned to fly at Mineola while an employee of the Moisant Aviation School in 1912 and was almost constantly employed as an exhibitor, tester or instructor from 1912 to 1917. He never had a serious accident.

Last summer besides testing airplanes for the Polson Iron Works of Canada, the Standard Aero Corporation, Heinrich Schmidt, and Charles Young, he was chief instructor of the First Aero Company, N. G. N. Y. When the First Aero Company was taken over by the Federal government Millman became a civilian employee of the United States Army.

On October 12, 1916, Millman married Miss May Schulz of Mineola, N. Y. Mrs. Millman survives him.

The Pensacola Flying School*

The navy flying school and station are located at Pensacola, Fla, where there is an excellent landlocked bay about five miles wide and fifteen miles long, which allows plenty of room for flying over smooth water. The bay is separated from the gulf by a narrow strip of land so that open sea flying can be had conveniently.

While the air conditions at Pensacola are not perfect, the majority of days are suitable for instructing beginners. It is considered undesirable to instruct beginners entirely in good air. They should be taught to handle themselves and their airplanes in all conditions of air which they will encounter in actual service. Some of the days at Pensacola give excellent practice in rough air flying.

Within two years Pensacola has developed from an abandoned navy yard to a well equipped and very busy aeronautic station. Concrete hangars for the accommodation of thirty six airplanes are under construction and all buildings are receiving equipment which is peculiar to the needs of aviation. New types of engines, airplanes and instruments are constantly being received and given exhaustive tests. The valuable data collected from these tests is being studied with a view to eliminating present faults and incorporating features of proven worth in future airplanes to be purchased or built.

A branch of aeronautics entirely new so far as our navy is concerned is being taken up with the purchase of a small dirigible, a captive kite observation balloon and a free balloon. These lighter-than-air craft have not been thoroughly tested and their worth is still a matter for conjecture based on the experience of others.

Qualifications of an Aviator

The ideas of those unfamiliar with aviation as to the qualifications considered necessary and desirable in an aviator are varied and vague. Some think that anyone who is willing to accept the risk can fly successfully, while others are inclined to believe that only certain individuals with reckless dispositions and a "sixth sense" of some sort are capable of making successful aviators. Neither of these ideas of course is correct.

It is generally conceded that aviation is a young man's work. The general board of the navy reported that experience in Europe showed that an aviator should not be over thirty years of age. While our army has no definite rule on the subject their aviators are chosen exclusively from young officers under thirty years of age. Usually a young man learns to fly more easily, and when he has learned makes a better flier. There are several reasons for this. Medical observers have proved that flying places more than the normal load on the nervous system, that a normal blood pressure is important and that perfect eyesight is necessary in order to judge short distances accurately while moving at high speeds. It is also essential that an aviator's heart action and sense of equilibrium be perfect.

Usually a man who is physically sound also has the proper kind of "nerve" to do what he chooses. There are, however, some temperamental qualities just as necessary to the aviator as a sound physique. An aviator who becomes startled or "rattled" simply courts disaster by flying. Confidence in himself and his ability at all times is absolutely essential. When an aviator is doing his real work he feels very much alone and to be successful he should possess that kind of determination which will allow him to take risks when there is no audience to applaud and when he would not be censured for taking them.

The Pensacola Course

When the student aviator reports for duty at the navy aeronautic station one of the instructors takes him for a "joy ride," just to show how it feels to fly. He is then required to provide himself with such textbooks as the commandant directs. These are principally on the mechanics of the airplane and the theory of aerodynamics. As a supplement to the study of these, frequent lectures are given. The student is required to master all the subjects thoroughly and close application is necessary to pass the monthly written examinations. Should the student fail to pass these examinations, he is detached from aviation duty. In addition to his theoretical studies and practical flying lessons, the student is required to take a practical shop course in airplane construction and high speed gasoline engine work. As assistant to a machinist he must actually tear down and rebuild every type of engine in use at the school. There has also been included in the course practical and theoretical work in dirigibles and balloons.

As often as weather and other conditions permit, the flying instructor takes his pupil for short flights, gradually allowing him to handle the controls as he becomes more and more at home and develops his "air feel." Only simple maneuvers are executed and each step in his training is worked up to gradually. After a total of ten hours actually spent in the air the student may be permitted to fly alone in good weather, provided he is apt and has satisfied at least two instructors that he can do so safely.

The average student will require between ten and twenty hours before being allowed to try it alone and this time will be distributed through two or three months. For some time after being allowed to fly alone the student is closely watched by the instructors, allowed to fly only in good weather and is given explicit instructions before each flight in what not to attempt. He is thoroughly examined by the medical officer once each week immediately after a flight, to ascertain whether the strain is developing any hidden physical defects.

As the Course Progresses

When the instructor is satisfied that the student has developed his "air feel" and some experience he allows him to begin his elementary flying. This consists of:

Executing spirals, high altitude flying, rough weather flying, courses by compass, and cross flights.

An apt and careful student may satisfy his instructors in three months as to his progress in elementary flying and is then allowed to begin his advanced flying course. This consists of:

Being launched from the deck of a ship underway by the "catapult."

Landing in deep sea waves and being hoisted aboard ship.

Scouting flights out of sight of land.

Air navigation.

Flying in formation.

Sending and receiving radio messages from the air.

When the student has passed all of his practical and theoretical examinations and his flying instruction is finished he is allowed to take his test for a naval aviator's certificate. The test comprises the following:

Climb to an altitude of 10,000 feet as shown by the recording barograph and glide to a normal landing, without porpoising, within 200 feet of a mark previously designated by the board; horizontal flight may be resumed twice during the descent but not within 1,000 feet, where the engine shall be cut off.

Make a spiral glide from an altitude of 5,000 feet as shown by recording barograph and land without porpoising within 200 feet of a given mark previously designated by the board.

Make a landing in a seaway where height of waves is at least four feet without damage to any part of the seaplane.

Make a straight course and return between two objects not less than five miles apart in a wind not less than 25 miles per hour and not more than four points forward or abaft the beam in order to demonstrate ability to maintain a given course.

Make a scouting flight over the open sea to a vessel that has been stationed at a designated bearing at a distance of 100 miles and returned to the starting point.

Demonstrate to the satisfaction of the board ability to fly in very bad weather.

Start a flight from the catapult after personally making all adjustments for its operation.

The student is then pronounced a full fledged aviator.

* From the *Marine Corps Gazette*

Aeronautical Patents

Copies of these patents may be obtained for 5 cents each by addressing the Commissioner of Patents, Washington, D. C.

ISSUED MARCH 13, 1917

1,218,571. Filed Aug. 9, 1916. To Joseph Sonnis, Ferris, N. J. Aerial bomb.

1,219,28[illegible]. Filed Sept. 12, 1911. To Edson F. Gallaudet, Norwich, Conn. An airplane.

1,219,1[illegible]. Filed June 22, 1916. To Thomas R. MacMechen and Walter A. Kamp, New York, N. Y. An airship.

1,219,121. Filed Dec. 1, 1915. To Thomas Rutherford MacMechen and Edwin Marshall Fox, Westminster, London, England. Airship or lighter than air.

1,219,123. Filed June 22, 1916. To Thomas R. MacMechen and Walter A. Kamp, New York, N. Y. An airship.

1,219,124. Filed June 22, 1916. To Thomas R. MacMechen and Walter A. Kamp, New York, N. Y. An airship.

1,219,125. Filed June 22, 1916. To Thomas R. MacMechen and Walter A. Kamp, New York, N. Y. An airship.

1,218,837. Filed Aug. 1, 1916. To William P. Bower and John G. Bower, Milwaukee, Wis. Flying toy.

ISSUED MARCH 20, 1917

1,219,616. Filed July 12, 1915. To Adolf Zylkiewicz, Meriden, Conn. Flying Machine.

1,219,703. Filed Oct. 7, 1915. To Mary Hannah Clark and Demetris Maggiora, Paris, France. Apparatus for dispelling airplanes and the like.

1,219,550. Filed Jan. 13, 1914. To Walter Hahnemann, Kitzeberg, Kiel, Germany. Antenna structure on airplanes for wireless signalling.

ISSUED MARCH 27, 1917

1,220,108. Filed Nov. 16, 1910. To Karol Skolowsky, Cleveland, Ohio. An Aerocycle.

1,220,374. Filed Feb. 1, 1915. To Maximillian Stupar, Chicago, Ill., assignor of one half to Herbert S. Renton, Chicago, Ill. An airplane.

New Sturtevant Biplane

R. M. Wright, pilot of the Sturtevant Aeroplane Company has been flying Sturtevant biplanes from the Squantum flying field frequently during the past fortnight. Progress is reported with the new Sturtevant pursuit biplane which is said to have made extraordinarily satisfactory performances while piloted by P. B. Acosta, chief instructor at the Government flying field at Mineola, L. I.

The Memphis Aviation Station

By Charles Chester

Sergt. First Class Aviation Co. "C," U. S. S. C.

The personnel and material of the U. S. Aviation Station, Chicago, Ill., under command of Capt. Joseph C. Morrow, Signal Corps, consisting of four officers, four flying instructors, eight student instructors, fourteen enlisted men of the Aviation Section, eleven sergeants of the Signal Enlisted Reserve Corps, twenty-three aviation mechanicians and sixteen airplanes arrived at Memphis, Tenn., early in February for winter training.

As soon as the personnel had located themselves in hotels and boarding houses the establishment of an aviation field under the direction of Capt. A. R. Christie, Signal Corps, was begun. The old Driving Park, the site chosen, was soon the scene of great activity, ten tent hangars being erected and eight airplanes assembled. Buildings on the grounds were occupied as offices and store rooms, a machine shop and an engine overhauling department were installed in ranged rooms. Victor Vernon made the first flight on February 8. Altogether nine flights were made on this day. On February 10 all the sergeants of the Signal Enlisted Reserve Corps were given their flying instruction.

An engine test block has been erected and the testing of engines by students under the direction of Wilfred G. Threader is being conducted. On February 20 Capt. Morrow lectured on aviation matters before the Rotary Club. Since their arrival here twenty-two sergeants of the Signal Enlisted Reserve Corps have reported for instruction in flying. The flying list now consists of three officers, six instructors, 8 student instructors, 30 sergeants S. E. R. C., three aviation mechanicians and three enlisted men (Regulars).

Student Instructor Mummert left February 28 for the Navy Aeronautical Station, Pensacola, Fla., for a course of training. Student Instructor Laird left March 1 for San Antonio, Tex., to act as instructor at the Stinson School of Flying.

Three minor accidents have occurred resulting in broken propellers, damaged wings and one complete wreck. Classes in aerodynamics, meteorology and elementary electricity have been organized for the aviation students under H. W. Flickinger. Principles of the Internal Combustion Engine with practical work in overhauling and testing and shrewd troubleshooting under Wilfred G. Threader. Military instruction and Infantry Drill Regulations under Sergt. First Class Charles Chester, S. C., field service regulations under Sergt. George F. Fisher, S. E. R. C.

On February 21 airplane No. 145 with Student Instructor, Charles M. Pond as pilot and George J. Klinberg as student fell about 70 feet, both pilot and student sustaining painful but not serious injuries. The machine was an almost total wreck.

Since the establishment of the station there have been about fifteen days of good flying weather; more than four hundred and fifty flights have been made with over one hundred and twenty hours in the air. Eight new airplanes from the factory fitted with the dual dep control have been received within the last few days, and the unloading, uncrating, assembling, checking and re-crating for instruction purposes is being carried on. It is expected that four more planes will soon be received.

Following is a list of the personnel under training at the Memphis Government Aviation Station:

Roster of Officers

Capt. Joseph C. Morrow, Signal Corps, Officer in Charge.

Capt. Arthur R. Christie, Officer in Charge of Training.

First Lieut. William R. Van Sant, Supply Officer.

First Lieut. William W. Spain, South Dakota National Guard, (Student).

Signal Enlisted Reserve Corps Sergeants

Albert L. Adams, Frank W. Alsip, Charles W. Browne, George F. Fisher, John M. Foot, Austin E. Gibson, Reuben H. Harper, Samuel A. Herrick, Percy N. Holloway, Eugene B. Jones, George J. Klinberg, George E. Knight, Earl E. Leonard, Donald Lyle, Alexander McLeod, Fletcher L. McCordic, Arthur Mitchell, Andrew C. Ortmayer, Harry W. Powers, Carlyle Rhodes, Harold M. Sanford, George J. Sauer, Rudolph W. Schroeder, Carlos B. Stevens, Thom C. Taylor, William A. Thompson, Joseph Von Walchshauser, Orrin E. Wolf.

Aviation Mechanician Students

Sergeants Michael L. Gerlowski, Grant P. Melvin and Victor J. Picard; selected civilian mechanicians Robert H. Houser, Joseph Paillsard, Julian Sykes and Wilfred G. Threader.

Enlisted Men of Aviation Co. "C," Signal Corps

Charles Chester, Sergeant first class, Sergeant Roy R. Showalter and William F. Jones, private first class.

There are nine airplanes in commission at the station.

Fort Omaha Ballooning Activity

Captain D. H. Bower and Lieutenant L. C. Davidson, U. S. A., accompanied by A. Leo Stevens, chief balloon instructor, U. S. A., made a successful balloon flight from Fort Omaha, Neb., to Maurice, Ia., a few days ago. The flight started at 1.40 P. M. and lasted 5 hours and 30 minutes, traveling 150 miles, an average speed of over 25 miles per hour. The course was almost due east. The balloon contained 19,000 cubic feet of hydrogen and required fifty hours to fill.

Air Squadron for San Diego

San Diego, Cal., has been selected by the War Department as the first city on the Pacific coast to be equipped with a squadron of battleplanes and seaplanes to act as scouts for the port's defense, according to official word received in that city from Washington. The company will comprise twelve seaplanes and three pursuit triplanes, all fitted with machine guns and bomb dropping devices. The personnel will consist of 16 aviators and 100 mechanicians, bomb throwers and radio operators.

Aviation Officers Sent to Europe

Major William Mitchell, Captain J. E. Carberry and Lieutenants M. F. Harmon, Jr., and Davenport Johnson, Aviation Section, Signal Corps, sailed from New York for Spain March 23, to study aviation training and military airplanes in foreign countries.

The Republic of France has generously offered to instruct American Army officers in the great strides made in aviation abroad since the start of the war. The necessity of organizing the American service has hitherto been so pressing that officers of the Aviation Section could not be spared.

Major William Mitchell of the Aviation Section, Signal Corps, has sailed for France to make a complete study of the recent developments in military aeronautics. He is making the trip by special authorization of the Secretary of War and with the approval of the French authorities. He will visit the leading French airplane and motor factories, the training schools as well as study the tactical and strategical use of airplanes at the front.

Major Benjamin D. Foulois, now in command of the air squadron at San Antonio has been ordered to Washington to take the position in headquarters left vacant by the detail of Major William Mitchell as observer in France. Major Foulois' place at San Antonio will be taken by Captain Townsend F. Dodd.

Some of the Personnel and Machines of the Army Flying School at Memphis, Tenn

Plans to Increase Factory Facilities

That the aeronautic branches of the army and navy are ready to buy many hundred airplanes and that between 1,800 and 2,000 applicants for instruction as aviators in the army and navy cannot be trained because the facilities of the country for the manufacture of the machines are far below the demands of the Government were revealed at the meeting of Aircraft Manufacturers, the National Advisory Committee for Aeronautics and representatives of the Army and Navy in Washington, March 22

Abundant appropriations have been made by Congress it was stated, but the Army and Navy are unable to spend this money because the facilities of factories are inadequate Consideration is being given to the enlargement of these facilities, especially to the feasibility of placing contracts for parts of machines with different factories and having the Government assemble them

Sidney Waldron, formerly president of the Packard Motor Car Company and several other retired manufacturers have offered their services without compensation to the Board in an effort to solve the problem of enlarging the aeronautic service

A report to the War and Navy Departments today from the Joint Board of Aeronautics recommended close co-operation between the Army and Navy aviation services

Recommendations by Army-Navy Board

Following are some of the recommendations:

"1 The board is of the opinion that the development of aeronautical resources of the United States and their application in war to the maximum national advantage can be accomplished best through the formation of plans and regulations for the joint development, organization, and operation of the aeronautical services of the Army and Navy, instead of by the separate development of each service within delimited exact areas of responsibility

"2 While the operations of the aeronautical service of the Navy will be principally over the water, and those of the Army principally over the land, it may be said that a war with a first-class power will find the two services constantly operating together The coast line and the water areas adjacent thereto will become a theatre of joint operations in which the naval aeronautical service will take precedence prior to the accomplishment of an invasion and subsequently the Army aeronautical service will take precedence if the hostile landing be accomplished, but in either case each service will be supplemented and supported by the other

"3 For the above reasons the board believes that pilots and observers for both services should be trained together so that each service may effectively supplement the other in time of need that joint training stations should be located on or near the coast and that in the selection of sites for the establishment of the permanent coast stations careful consideration should be given to their suitability for joint occupancy

"4 While there is an ample field for each service to proceed along its own line in the development of the types of aircraft best suited to meet its particular needs the board believes that the types adopted by the Army and Navy should be as nearly alike as may be consistent with the particular service required of each; that the motive machinery and control should be standardized and that in this development there should be had the mutual interchange of ideas and joint co-operation that now obtain in the design and construction of the first Zeppelin The board believes also that if either service should establish a plant for the construction of aeronautical machines or accessories the other service should be privileged to use it under such control as may be deemed necessary by the service constructing the plant

"5 It is believed to be neither practicable nor desirable to specify the exact line at which the operations of either service should begin or end, although such a line if drawn, would coincide approximately with the coast lines of Continental United States and of each of the overseas possessions the Army operating over the land, the Navy over the sea, but each extending its operations locally into the other's area as occasion requires Keeping in mind however, that the two services will be called upon in many cases to act conjointly their respective responsibilities and spheres of action may be defined in general as follows

"Army responsibility

(a) Aircraft operating in conjunction with the mobile army

(b) Aircraft required for fire control for coast defenses.

(c) Aircraft required for the defense of fortifications navy yards, arsenals cities, ship building plants powder works, or other similar important utilities, whether public or private, that are located on shore

"Navy responsibility

(a) Aircraft operating in conjunction with fleet.

(b) Aircraft operating from shore bases for overseas scouting

(c) Aircraft operating under the commandants of naval districts and adjacent bases.

6 In general it may be said that it is primarily the duty of the Army to defend harbors cities, and all manufacturing or other utilities that are located on shore and that it should be charged with the organization of the aircraft service for this purpose, and that the operations of the navy aeronautical service will be principally over the sea although it will require bases on shore probably under the commandants of naval districts. It should be the duty, however of the army and naval commandants in coastal districts to familiarize themselves with the plans of each other with a view to effective co-operation both on land and sea"

Government Making Air Maps

The first practical steps ever taken in this country for systematically mapping landing fields for airplanes is being undertaken by the Aviation Section Signal Corps U S A, at the Mineola, L. I., station This plan was worked out by Captain J E Carberry formerly in command at Mineola in conjunction with officers of the First Reserve Aero Squadron Signal Officers Reserve Corps, which is commanded by Major R C Bolling, S O R C

The plan is the outgrowth of the cross country flying which is being done constantly at Mineola by officers of Major Bolling's command.

(c) International Film Service

Firing an Airplane Rocket at Mineola, L. I.

These reserve officers found that they were making flights several times a week between Governor's Island and Mineola. It was decided to map and mark all the good landing fields as well as the emergency landing fields between the two points By securing the co-operation of Captain Carberry it has been possible to carry out this work The plan is to map out the landing fields on Long Island to the east of Mineola and gradually expand the work until all Long Island Westchester County, N Y, the Connecticut seaboard as far east as New London and the route from New York to Philadelphia are all charted

Photographic charting is being used as well as hand sketching

Cameras in Target Practice

The camera is to take another important part in training the civilian aviators. It is to be used in target practice With a camera mounted on his machine instead of a machine gun, but operated by regular gun sights and trigger pull, the student aviator will soon be sent up with orders to "bring down" a certain machine designated as the enemy The scheme works on the natural presumption that if a flier can aim well enough to get a bull's eye through his camera he could do it with a rapid fire gun

Arrival of the speedy pursuit machines for the reserve squadron is expected toward the end of May

Aeronautic Material Cannot Be Supplied

Lord Douglas Gray of the British Aviation Service is reported to be at Daytona Beach Fla conducting research work with automobile engines He is quoted as having said in a recent interview

At present the airplane situation in this country is such that the demand for machines cannot be half supplied There is only one company in the United States that is manufacturing machines in large numbers These airplanes cost between $10,000 and $25,000 and the British government is glad to buy them in lots of 1,000 They are indispensable in warfare and England and the other allies must have them While the demand for machines is at present so great I venture to say that it would be doubled or trebled in case of a declaration of war between this country and Germany

Looping in Seaplane

Looping-the-loop in a seaplane was done recently by Captain Francis T Evans of the United States Marine Corps at Pensacola This marks the first time the feat has been accomplished in the United States The heavy float landing gear which carries with it much in the way of head resistance has always prevented looping in seaplanes Captain Evans used a Curtiss training tractor of the N 9 type in accomplishing the "stunt" He turned two loops and then descended

Fifty-four Students at San Diego

The recent addition of six Regular Army lieutenants to the number of officers on duty at the San Diego flying school brings the total number of officers of the Regular Army and National Guard now on duty at the school up to 54

Aircraft Manufacturers' Meeting

The aircraft manufacturers of the United States met in an all day meeting with the executive committee of the National Advisory Committee for Aeronautics recently considered ways and means to speed up this nation's aerial preparedness The meeting was presided over by Dr Charles D Walcott.

The principal development of the meeting was the appointment of a special committee to work on minute details for speeding up production of aircraft and temporary standardization of types of aircraft to be required by the Army and Navy. This committee will consist of four members of the National Advisory Committee for Aeronautics and three representatives of the Aircraft Manufacturers Association.

The prospective needs of the Army and Navy for the next two or three years were discussed The apportionment of orders by types to the factories with the best facilities for quantity production and the standardization of materials used in aircraft were considered There was discussion of the steps that should be taken by the Government to mobilize the important materials that will be necessary in aircraft manufacture and of the policy of the Army and Navy in the testing and inspection of engines materials and completed aircraft

There appeared to be a strong sentiment in favor of a cross licensing agreement of aeronautic patents Mr Coffin and Mr Walcott explained the steps in the organization of the National Automobile Chamber of Commerce, and the applicability of similar measures to the aeronautic industry

The following is a list of those present at the meeting.

Dr Charles D Walcott Chairman, Dr S W Stratton Secretary Dr Joseph S Ames Dr Charles F Marvin, Dr Michael I Pupin, Brig General George O Squier, U.S.A., Rear Admiral D W Taylor, U.S.N., Lieut J H Towers U.S.N., Howard E Coffin, Sidney D Waldon and Dr W Christmas, G H Cockley, A H Flint, Henry M [illegible], L B Gallaudet, B A [illegible], G H Houston, William H [illegible], M Keyes, Glenn L Martin, H B Mingle, W B [illegible], F G [illegible], Israel Ludlow, J T Moore, F H Russell, J W Smith, Henry [illegible], Theodore [illegible], Major C S Wallace, Lee S Wallace, Harry D Westcott, Benjamin D L Williams, Charles F Willard, Samuel Quinn, Eugene S Robinson, Charles B King, F S Duesenberg, Warren S Eaton

Army Training Five Hundred Boys

Five hundred students have been ordered to Miami Fla., to take a six months' course of training in aviation in preparation for service with the United States Aviation Corps, in case of war according to newspaper reports More than 100 students have enrolled for aviation training and some more of them will probably be ordered to Miami in the next few weeks The others will take three months training this summer and the next.

Two of the men who will leave for Miami are football men Hamilton Coolidge of Brookline who was substituted end of the eleven last fall, and Worthington Davis of New York, substitute tackle The others are Arthur Harvey of Kansas City and John Mitchell of Manchester They will report first to Key West, where they will enlist in the Army for six months They will receive commissions as officers in the Aviation Section of the Signal Officers Reserve Corps, if they succeed in passing the tests in aviation at the end of the training They have already passed the physical and mental examinations required of all applicants.

Army Air Station at Essington, Pa.

A temporary aviation station has been established by the Aviation Section, Signal Corps, U S A, at Essington, Pa., for the organization of the Philadelphia Aero Squadron, Signal Officers Reserve Corps

The information was contained in a telegram received by Robert E Glendinning, president of the Philadelphia School of Aviation, from General George O Squier, Chief of the Signal Corps of the United States War Department Washington D C, announcing the decision of the department to purchase all of the equipment of the school and lease the land at Essington Delaware county where the school now has its field headquarters The telegram received by Mr Glendinning read

Proposition to establish temporary aviation station for organization of Philadelphia squadron approved by War Department. If agreeable to you immediate steps will be taken to lease land and to purchase as much of your equipment as is suitable for our use and for which authority exists. Please telegraph your decision Telegram is being sent this date to Walter E Johnson in reference to employment of himself and others.

Johnson referred to in General Squier's telegram is in charge of the Essington station at present where he is filling the position of chief instructor. Seven men comprise the staff maintained at the station by the school

Eighteen Acres in Station

The station as organized contains eighteen acres of land leased from the city The equipment consists of hangars providing accommodations for twelve airplanes a thoroughly equipped machine shop suitable barracks for the accommodation of twenty five men gasoline reservoirs and oil supply tanks, besides steam boat and landing piers.

"The acceptance by the government of the Philadelphia Aviation School's property and equipment insures the establishment and maintenance here of a thoroughly equipped government aviation station and school of instruction said Mr Glendinning It also means the city is provided with an effective defensive arm in case of war There seems every reason for believing the Philadelphia station will become one of the most important, if not the most important aviation unit on the Atlantic Coast."

The Essington School of Aviation has been conducted under private auspices and by private capital for more than a year The moving spirit in all the work done at the school has been Mr Glendinning Others interested in the school are Judge J Willis Martin, Alexander Van Rensselaer B Franklin Pepper Anthony J Drexel Biddle, George C Thomas, Frank H Maguire and Edward Cheston

Within a few hours after the announcement that the United States War Department had decided to take over the Philadelphia School of Aviation at Essington for the purpose of converting it into a base for air squadrons to cooperate with the Atlantic reserve fleet at League Island supplies from the Government began arriving at Essington.

Capt Ocker in Charge

Nor did the War department lose any time in placing an officer at the head of the school for it was announced that Captain William Ocker, who recently flew from Long Island to Washington carrying Congressman Bleakley, of Franklin Pa from this city to the capital would take active charge at once Captain Ocker is an officer in the United States Reserve Corps having recently been promoted from the rank of sergeant

About $2,000 worth of cable wire, several typewriters and other office equipment have already arrived at the school Bills of lading received by Walter E Johnson, who has been chief instructor, show that four airplanes, two motor trucks, two motorcycles, two motorboats—capable of making forty five miles an hour—and considerable machine shop equipment are already on their way to Essington

The Government, having decided to maintain a base for an aerial fleet and a school for the training of reserve air squadrons at Essington, will spare neither money nor effort for its development. It is said that the War department is prepared to spend $250,000 to make it an efficient arm of the United States fighting forces

Walter E Johnson recently announced that the station would commence schooling activities about May 1, and 100 pilots was the number estimated that it would be possible to turn out this summer

Aviation Sites Sought

A joint Army Navy board is studying the Atlantic and Gulf coasts preparatory to the establishment of eight aeronautic stations, which, besides having two dirigibles and six or eight seaplanes each for aerial patrol work, probably will serve as bases for the new 110-foot coast scout boats of which the navy will order more than 100 in a few days

Brigadier General George O. Squier is the head of the board

Sixteen dirigibles and a sufficient number of seaplanes already have been contracted for, and officers and men for the air service are being selected, to be sent to the station at Pensacola, Fla, for training

The eight stations will be distributed along the coasts to cover strategic areas to be determined by the board Each will require six officers and forty men.

Canal Station Selected

The only site already definitely selected is that at Coco Solo, near Colon, Canal Zone for which an appropriation of $1,000,000 to establish a joint aviation and submarine base was asked of the last Congress The project is expected to go through at the coming special session.

Funds for the other stations will also be asked at that time, but the department has emergency appropriations sufficient to begin the work at once The dirigibles are to be delivered within four months

At present no stations for the Pacific Coast are being prepared, although the chain of coast patrol bases will be extended along the entire coast line as rapidly as machines can be obtained and men trained

Immediate Training Provided

The immediate plans require the training within the next four months of fifty officers and 250 men at Pensacola in handling dirigibles Crews for the seaplanes are already under training, but their number will have to be increased largely without delay

Wire Entanglements Guard Curtiss Plant

In view of the extensive operations of the Curtiss aeroplane factory at Hammondsport, N. Y., which is engaged upon large contracts for the United States government, it has been deemed advisable to throw further protection about the plant To that end a tall fence with barbed wire entanglement is being constructed about the grounds and buildings There are but two entrances through this barrier both of which are guarded by watchmen day and night

Report on Army Airplanes in Mexico

Some very interesting information has recently been furnished by officers of the United States Army relative to flights made during the past few months by Curtiss R4 airplanes on the Mexican border. For about six weeks last summer mail airplanes left Columbus, N. M., every other day for General Pershing's headquarters at Colonia Dublan, Mexico, about 115 miles south. A return trip was made the next day. All first class mail for troops was carried by airplane and on some trips all classes of mail up to 300 lb. in weight. Bulk of the mail, not the weight, was usually the limiting factor.

All planes flying from one station to another carried mail, averaging about two mail carrying flights per week for six months. The average distance the mail was carried each flight was about 160 miles.

In addition to mail all sorts of articles have been carried, as the following list taken at random shows:

	Lbs.
Pilot and passenger. Military equipment consisting of army, food, water, tools, first aid packet, sleeping bags	140
Mail, 3 bags	130
Two spare magnetos	40
Butter	30
Bedding	12
Candy	4
Jam	10
Total	400

Not a single piece of mail was lost. The average flying time between Columbus and Colonia was 1 hour and 17 minutes, while the longest was 2 hours, for the 115 miles.

Hall-Scott Four Ran Over 100 Hours in the Air

A Hall-Scott A-7a 90 hp. 4-cylinder engine, in a Martin model T. T. airplane at the Army School at San Diego, Cal., recently completed 102 hours and 30 minutes without being overhauled or taken out of the airplane, according to L. S. Scott, secretary of the Hall-Scott Motor Car Company.

"The engine was not removed for loss of power," writes Mr. Scott in a letter to AVIATION AND AERONAUTICAL ENGINEERING, "but simply because a water pump required repacking and they were really afraid to run it longer as they were not used to running an engine anywhere near 100 hours. We offered to put in another pump but the officers in command did not wish to let it go longer and of course as it was their engine we had nothing to say."

Detroit Club Elects Strong Officers

At the annual meeting of the Aero Club of Detroit the following officers were elected: Sidney D. Waldon, president; Henry B. Joy, vice-president; Fred M. Alger, vice-president; R. D. Chapin, treasurer, and Mason P. Rumney, secretary.

Following are the newly elected governors: A. Verville of the General Aeroplane company; G. W. Dunham, consulting engineer; William B. Stout, airplane engineer of the Packard Motor Car company; K. W. Zimmerschied of the General Motors company; D. McCall White, engineer of the Cadillac Motor Car company; R. O. Gill, manufacturing manager of the Saxon Motor Car company, and R. W. Judson, vice-president of the Continental Motors company.

A committee was appointed also, to recommend sites and landing places, to be purchased by the government in connection with aerial defense. The club, which has as its object the furtherance of public interest in aerial matters, the promotion of airplane manufacture and aerial defense, has reduced its membership fees so as to permit many persons interested in its work whose means do not allow them to become members at the present rates, to join the club.

Hydraulic Forging of Cylinders

The following information on their methods of forging steel cylinders for airplane engines hydraulically, has been supplied to AVIATION AND AERONAUTICAL ENGINEERING by a representative of the Tioga Steel and Iron Company, Philadelphia, Pa.

The company has made a specialty for the past year of hydraulically hollow forging steel airplane cylinder forgings. By their method of making these the steel is closely confined in dies under continuous pressure, which makes the metal very dense and uniform, thus greatly increasing the physical properties and at the same time produces a superior wearing metal for cylinder construction. Thus airplane engine builders are not only able to save a considerable amount of machine work as compared with machining these cylinders from a solid bar or billet, but are assured of a much better cylinder and the elimination of pipes.

They are able to make these cylinders of high or low carbon, or alloy steels, such as chrome nickel, etc. They further carry at all times a large stock of steels, which enables them to make very prompt shipments. They also make a specialty of forging propeller hubs, flanges and shafts, on which they are in position to make prompt shipments.

Their shop is equipped with large and small steam hammers and large and small hydraulic forging presses, which enables them to cover a very wide field and they have built up a large business by being able to take care of rush requirements.

They have made a specialty of hydraulic pressed die forgings for many years and are leaders in this particular class of work.

Connecticut Naval Militia Aviation Corps

A new Naval Militia Aviation Corps has been formed at Bridgeport, Conn., and is composed of twenty-three men. Ensign John H. Cooper is in command. Ensign Cooper left Bridgeport a few days ago in charge of the following men to report to Pensacola, Fla., for three months training:

Warren S. Renolds, Chief Machinist's Mate; Leon S. Moran, Machinist, 2nd class; James V. Porta, Electrician, 3rd class; LeRoy Sweeney, Electrician, 3rd class.

Airplane Machine Guns

In accordance with orders from the War Department, Adjutant General Stewart of Pennsylvania has directed that twenty-one machine guns now in possession of infantry regiments of the National Guard be sent to Buffalo for use in aviation work. The guns are to be replaced as soon as possible with the new issue of machine guns by the War Department. There are about thirty-six machine guns now in use by the National Guard of Pennsylvania.

"Bob" Fowler on Pacific Coast

Robert Fowler, the transcontinental flier, is said to be carrying on negotiations at the present time which may lead to the establishment of an airplane factory near Vallejo, Cal., for the construction of airplanes and seaplanes for the Government.

Airplane Factory at Davenport, Ia.

Plans are maturing for manufacturing airplanes at Davenport, Ia. Decker French, Richard Lane and Reed Lane are backing the venture.

William Cook has been retained as head of the construction work. The factory will commence operations by laying out three training tractors. Later the prospects are that the production will be increased to from four to six airplanes a month.

Aerodrome at Willow Grove, Pa.

Realizing the necessity for a land flying field near Philadelphia in the event of war, the Philadelphia Motor Speedway Association has offered 400 acres of land on its grounds at Willow Grove, Pa. The ground is level and is admirably suited for either an aviation base or military training quarters. It is only sixteen miles from Philadelphia. From this point aviators could reach the Jersey coast, New York harbor or Delaware Bay in short time. The grounds are large enough, in fact, to be used as both aviation and military training camps.

Should war follow the present crisis, it is highly probable that the War Department would take advantage of the suggestion.

In a letter to Charles L. Howell, secretary-treasurer of the association, Secretary of War Baker expressed the thanks of the department for the offer and said that it would be accepted should the necessity arise.

The Death of James R. McConnell

James R. McConnell, Sergeant Pilot of the Escadrille Lafayette with the French Flying Corps, was killed early in March in an air combat with three German airplanes near Chaulnes, France, while carrying out aerial reconnaissance over the retreating German troops.

McConnell's home was Carthage, N. C. At the outbreak of European hostilities, he joined the American Ambulance service in France. While serving with the Ambulance he was cited for bravery.

In 1915 McConnell joined the Flying Corps, undergoing the usual six months' course of training and then went to the Verdun front with the American Escadrille. He flew constantly over the German lines for more than twenty months, always in one of the speedy *avions de chasse*.

The article "How France Trains Pilot Aviators," published anonymously in the Nov. 1, 1916 issue of AVIATION AND AERONAUTICAL ENGINEERING, was by McConnell, who wrote in a letter transmitting the article:

"It strikes me that the subject ought to be of interest, especially since America is starting out to build an aerial fleet and to train pilots to man it."

James McConnell joined the French Flying Corps because he felt the justice of the cause for which he fought. He died in action. His death marks the passing of another of the American fliers.

Norman Prince, Victor Chapman, Kiffin Rockwell, and now James McConnell by giving their lives fighting for France have rendered even greater service to the United States. They died fighting for the same ideals of liberty and self-government for which Lafayette and Rochambeau fought in helping to win this country's independence nearly a century and a half ago.

Aeronautical Departments Are Guarded

Heavy guard has been thrown around the aeronautical departments of the Goodyear and Goodrich companies, according to the special Akron correspondent of *The Rubber Age*, since construction work has begun on dirigible balloons for the United States Navy. Akron recently became the center of manufacture for lighter-than-air fighting machines when local concerns were awarded contracts to build eleven out of sixteen dirigibles ordered by the Navy.

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Aeronautical Trade Directory

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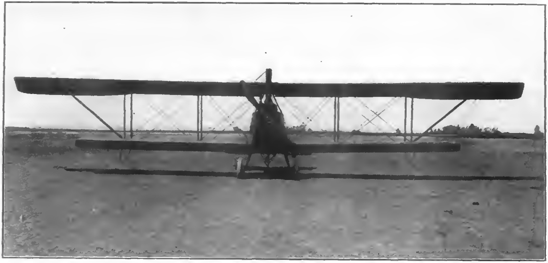

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